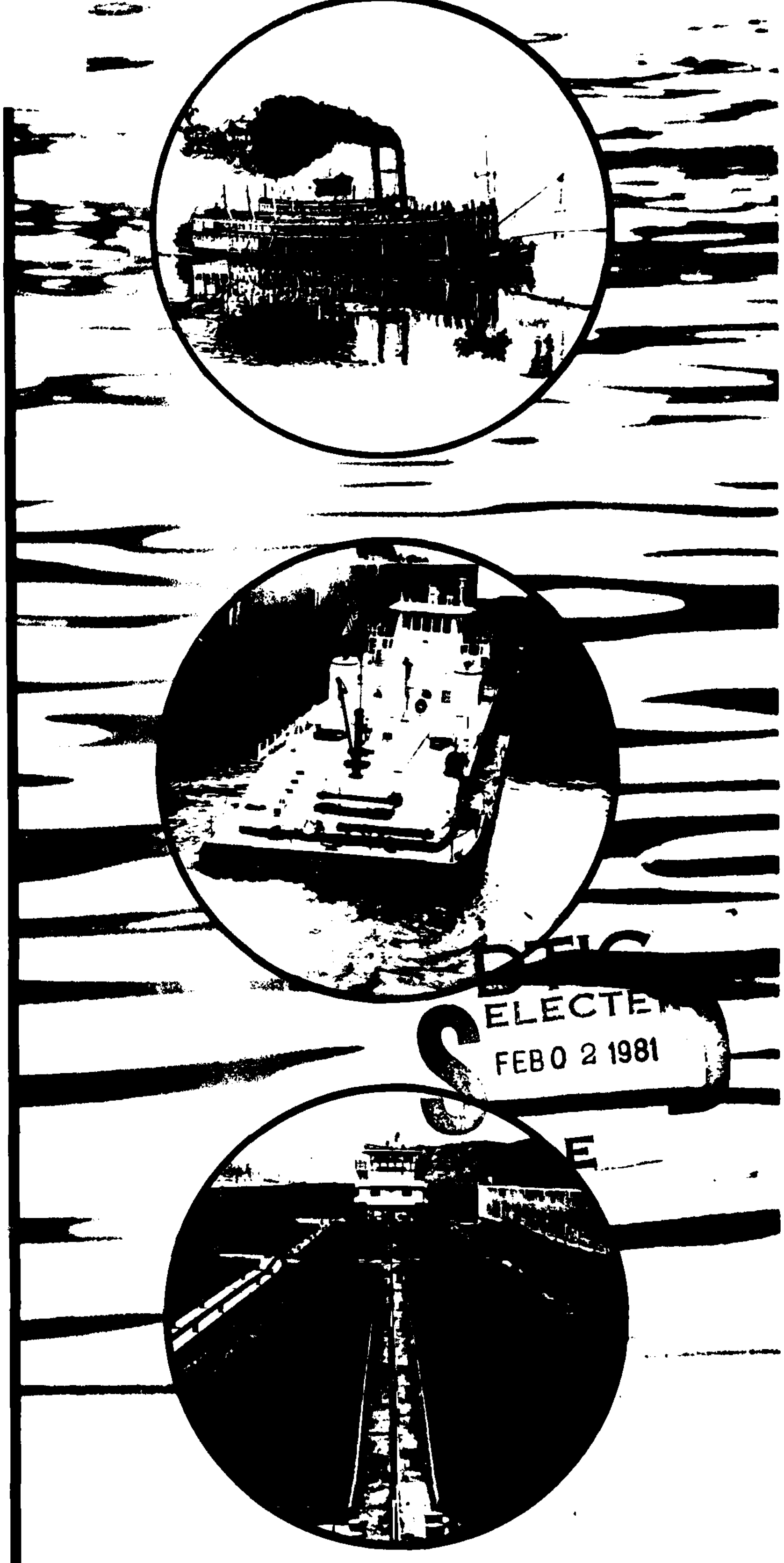
AD-A094 360 NATHAN (ROBERT R) ASSOCIATES INC WASHINGTON D C F/G 5/3
PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION, OHIO RIVER--ETC(U)
DEC 80 DACW69-78-C-0136
UNCLASSIFIED NL

1 OF 1
AD A
094360

END
DATE
FILMED
2-81
DTIC

Projections Of Demand For Waterborne Transportation

Ohio River Basin 1980 - 2040



Volume 4

Petroleum Fuels

U. S. Army Corps of Engineers
Ohio River Division
Cincinnati, Ohio

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A094360	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Projections of Demand for Waterborne Transportation, Ohio River Basin 1980, 1990, 2000, 2020, 2040; Vol. 4, Group II: Petroleum Fuels A094359		5. TYPE OF REPORT & PERIOD COVERED Vol. 4 of 17
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) DACW69-78-C-0136
9. PERFORMING ORGANIZATION NAME AND ADDRESS Robert R. Nathan Associates, Inc. Consulting Economists 1301 Pennsylvania Ave., N.W. Washington, DC 20004		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Ohio River Basin Navigation Studies
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Corps of Engineers, Ohio River Div. ATTN: Navigation Studies Branch, Planning Div. P.O. Box 1159, Cincinnati, OH 45201		12. REPORT DATE December 1980
		13. NUMBER OF PAGES 66
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) U.S. Army Corps of Engineers, Huntington District P.O. Box 2127 Huntington, WV 25721		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Bulk cargo	Market demand analysis	Petroleum
Commodity resource inventory	Modal split analysis	Crude oil
Economic development	Ohio River Basin	Petroleum transportation
Economic forecasting	River basin development	
Inland waterways	Traffic surveys	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System. Each of the studies considers existing waterborne commerce and develops a consistent set of projects of future traffic demands for all of the navigable waterways of the Basin. Each report contains information on past and present waterborne commerce in the Basin and projections by commodity groups and origin-destination areas from 1976 to at least 1990.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(Continued from #20)
The three study projections, in conjunction with other analytical tools and system information, will be used to evaluate specific waterway improvements to meet short and long-term navigation needs. The output from these studies will serve as input to Corps' Inland Navigation Simulation Models to help analyze the performance and opportunities for improvement of the Ohio River Basin Navigation System. These data will be used in current studies relating to improvement of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, the Cumberland River and the Tennessee River, as well as other improvements.

This document is volume 4 of the 17 volume report shown below.

The study included a Commodity Resource Inventory, a Modal Split Analysis and a Market Demand Analysis. The work included investigation and analyses of the production, transportation and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of and within the Ohio River Basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A study summary aggregates the commodity group totals for each of the several projections periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin. The study results are presented in the following 17 documents:

Volume	Subject Title	
1	Study summary	
2	Methodology	
3	Group I:	Coal and coke
4	Group II:	Petroleum fuels
5	Group III:	Crude Petrol.
6	Group IV:	Aggregates
7	Group V:	Grains
8	Group VI:	Chemicals and chemical fertilizers
9	Group VII:	Ores and Minerals
10	Group VIII:	Iron ore, steel and iron
11	Group IX:	Feed and food products, nec.
12	Group X:	Wood and paper products
13	Group XI:	Petroleum products, nec.
14	Group XII:	Rubber, plastics, nonmetallic, mineral, products, nec.
15	Group XIII:	Nonferrous, metals and alloys, nec.
16	Group XIV:	Manufactured products, nec.
17	Group XV:	Other, nec.

Additionally, an Execu ive Summary is available as a separate document.

9 Final rept.

GROUP III. PETROLEUM FUELS.

6

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION, OHIO RIVER BASIN, 1980, 1990, 2000, 2020, 2040. Volume 4.

Prepared for

U.S. ARMY CORPS OF ENGINEERS
OHIO RIVER DIVISION, HUNTINGTON DISTRICT

15

Contract No. DACW69-78-C-0136

by

Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

12 70

11

DECE[redacted]980

407669

4/3

A limited supply of this report is available at cost (please prepay, with checks payable to the United States Treasurer) from:

Division Engineer
U.S. Army Engineer Division, Ohio River
ATTN: ORDAS
P.O. Box 1159
Cincinnati, OH 45201

The price of the several documents of the report is as follows:

Executive Summary:	no charge
Volume 1:	$4.00
Volumes 2, 3, 7 and 10:	$3.00 each
All Others:	$2.00 each

The entire set of 17 volumes: $40.00

An unlimited supply of this report will soon be available from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Library cataloging information:

Robert R. Nathan Associates, Inc.
Projections of demand for waterborne transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040 / Prepared for the U.S. Army Corps of Engineers, Huntington District ... by Robert R. Nathan Associates, Inc., December 1980. Cincinnati, Ohio : U.S. Army Corps of Engineers, Ohio River Division, 1980.
17 v. : ill. ; 28 cm.
Contract DACW69-78-0136.
"...one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System."

CONTENTS: v.1. Study summary.--v.2. Methodology.--v.3. Commodity groups .

1. Shipping--Ohio River Basin. 2. Inland water transportation--Ohio River Basin--Statistics. 3. Ohio River Basin. I. United States. Army. Corps of Engineers. Ohio River Division. II. United States. Army. Corps of Engineers. Huntington District. III. Title.

HE597.03N3 OCLC no. 7030444

PREFACE

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River basin navigation system. Each of the studies considers existing waterborne commerce and develops a consistent set of projections of future traffic demands for all of the navigable waterways of the basin. Each report contains information on past and present waterborne commerce in the basin with projections by commodity group and origin-destination areas from 1976 to either 1990 or 2040.

The three projections, in conjunction with other analytical tools and waterway system information, will be used to evaluate specific waterway improvements required to meet short and long-term navigation needs. The output from these studies will serve as input to Corps inland navigation simulation models to help analyze the performance and requirements for improvements of the Ohio River basin navigation system. These data will be used in current studies relating to improvements of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, and the Tennessee River, as well as for other improvements.

The reports on the three studies are referred to as the "CONSAD," the "BATTELLE," and the "NATHAN" reports. The latter and final report was completed in November 1980. It was prepared for the Corps of Engineers by Robert R. Nathan Associates, Inc., Consulting Economists, Washington D.C. This study encompasses the period 1976-2040, and is by far the most detailed of the three.

The "CONSAD" report, completed in January 1979, was prepared for the Corps by the CONSAD Research Corporation of Pittsburgh, Pennsylvania. The study and the 1976-1990 projected traffic demands discussed in that report were developed by correlating the historic waterborne commodity flows on the Ohio River navigation system, with various indicators of regional and national demands for the commodities. The demand variables which appeared to best describe the historic traffic pattern for each of the commodity groups was selected for projection purposes. The projected values for the demand variables are based upon the 1972 OBERS Series E Projections of National and Regional Economic Activity. The OBERS projections serve as national standards and were developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, in conjunction with the Economic Research Service of the Department of Agriculture.

The "BATTELLE" report was completed in June 1979, and was prepared for the Corps by the Battelle Columbus Laboratories, Columbus, Ohio. The study and the 1976-1990 traffic projections discussed in that report were developed by surveying all waterway users in the Ohio River Basin through a combined mail survey and personal interview approach. The purpose of the survey was to obtain an estimate from each individual shipper of his future commodity

movements, by specific origins and destinations, as well as other associated traffic information. All identifiable waterway users were contacted and requested to provide the survey information. In addition, personal interviews were held with the major shippers. The responses were then aggregated to yield projected traffic demands for the Ohio River navigation system.

The "NATHAN" report presents the findings of a commodity resource inventory, a modal split analysis and a market demand analysis. The work included investigation and analyses of the production, transportation, and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of, and within the Ohio River basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A Study Summary and an Executive Summary present appropriately abbreviated discussion and findings resulting from these analyses. The Study Summary aggregates the commodity group totals for each of the several projection periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin.

The "NATHAN" report, "Projections of Demand for Waterborne Transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040" consists of the following volumes:

Subject Title	Number of Pages	Volume Number
Study Summary	220	1
Methodology	118	2
Group I: Coal and Coke	134	3
Group II: Petroleum Fuels	66	4
Group III: Crude Petroleum	42	5
Group IV: Aggregates	64	6
Group V: Grains	131	7
Group VI: Chemicals and Chemical Fertilizers	90	8
Group VII: Ores and Minerals	61	9
Group VIII: Iron Ore, Steel and Iron	104	10
Group IX: Feed and Food Products, Nec.	44	11
Group X: Wood and Paper Products	61	12
Group XI: Petroleum Products, Nec.	38	13
Group XII: Rubber, Plastic, Nonmetallic Mineral Products, Nec.	41	14
Group XIII: Nonferrous Metals and Alloys, Nec.	57	15
Group XIV: Manufactured Products Nec.	35	16
Group XV: Others, Nec.	48	17

Additionally, an Executive Summary is available as a separate document.

RRNA

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION OHIO RIVER BASIN 1980, 1990, 2000, 2020, 2040

Group II: Petroleum Fuels

Prepared for
U.S. Army Corps of Engineers
Huntington District
Contract No. DACW69-78-C-0136

by
Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

November 1980

TABLE OF CONTENTS

I. INTRODUCTION

Group II, petroleum fuels, consists of six major, relatively high-gravity petroleum liquids derived from crude oil refining. The waterborne movements of this group increased from 9.2 percent of total Ohio River System (ORS) waterborne movements in 1969 to 10.7 percent in 1976.

The areas within the Ohio River Basin (ORB) for which projections of Group II consumption, production and movements have been made are designated as Primary Study Areas (PSAs). The PSAs for Group II are those U.S. Department of Commerce Bureau of Economic Analysis Areas (BEAs) and area segments (aggregations of counties within a BEA) which are origins or destinations of Group II waterborne movements. Appendix Map A-1 presents Group II PSAs.

In addition to the PSAs, external areas linked to the ORB through waterborne commerce were identified. Areas (BEAs) outside the ORB which are destinations of waterborne petroleum fuel movements originating in the ORB are designated as Secondary Consumption Areas (SCAs). Areas (BEAs) outside the ORB which are origins of Group II waterborne movements destined to the ORB are designated as Secondary Production Areas (SPAs).

A. Description of Group II

The individual products included in Group II are:

Waterborne Commerce Statistics Code (WCSC)	Product/Commodity
2911	Gasoline, including natural gasoline

2912	Jet fuel
2913	Kerosine
2914	Distillate fuel oil
2915	Residual fuel oil
2921	Liquefied petroleum gases, coal gases, natural gas, and natural gas liquids.

During the 1969-76 period, gasoline, jet fuel, distillate fuel oil and residual oil accounted for 95 to 98 percent of the total waterborne shipments of the group.

B. Existing Waterway Traffic Flows

In 1969, the waterway traffic flows of Group II in the ORS were recorded at 14.7 million tons. By 1976, traffic had increased to 20.9 million tons, representing an average annual growth rate of 4.0 percent. Most of this growth was attributed to inbound and local shipments (Table 1).

B-1. BEA-to-BEA Traffic Flows

The transportation of petroleum fuels in the Ohio River System is very extensive. In 1976, 20.9 million tons of petroleum fuels were shipped from port equivalents (PEs) in 26 BEAs, both inside and outside the Ohio River Basin and to 25 BEAs in more than ten states. In the ORB, 14 out of 15 waterside BEAs were origins or destinations of waterborne traffic of petroleum fuels of one type or another.

B-2. Highlights of Important Links

Table 2 presents the BEA-to-BEA waterborne flows of petroleum fuels, as reported for 1976. Waterborne shipments of petroleum fuels from BEAs outside the ORB to BEAs within the ORB accounted for 29.9 percent of the total inbound shipments of all commodity groups. Outbound and local shipments accounted for 4.8 percent and 7.5 percent, respectively.

Table 1. Ohio River System: Waterborne Shipments of Petroleum Fuels by Commodity
Inbound, Outbound, and Local Movements, 1969-76

(Thousands of tons unless otherwise specified)

Commodity and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Total	14,681.9	15,573.5	16,191.3	17,514.8	17,922.8	18,994.8	18,891.0	20,943.4	5.2
Inbound	6,721.5	7,411.5	7,611.4	7,970.3	8,735.8	9,256.6	8,751.5	8,814.8	3.9
Outbound	1,080.7	1,084.5	1,010.6	1,076.3	934.6	1,142.5	1,107.7	1,293.1	2.6
Local	6,879.7	7,077.5	7,569.3	8,468.2	8,252.4	8,595.6	9,031.9	10,835.5	6.7
Gasoline	10,359.3	11,280.8	11,216.2	10,949.6	10,557.2	10,191.4	10,112.5	11,063.1	0.9
Inbound	4,990.2	5,518.2	5,182.2	4,979.7	4,651.4	4,491.1	4,161.1	4,292.2	(2.1)
Outbound	599.9	696.8	527.5	623.4	596.6	648.9	765.3	749.1	3.2
Local	4,769.2	5,065.8	5,506.5	5,346.5	5,309.2	5,051.4	5,186.1	6,021.8	3.4
Jet fuel	667.1	599.2	824.2	728.9	847.8	886.9	837.8	318.3	(10.0)
Inbound	219.6	220.0	288.3	306.8	361.6	325.7	372.1	130.3	(7.2)
Outbound	19.4	60.5	176.6	85.4	200.0	209.6	65.7	--	a
Local	428.1	318.7	359.3	336.7	286.2	351.6	400.0	188.0	(11.1)
Kerosine	398.8	485.5	475.6	459.2	474.7	355.7	261.1	477.6	2.6
Inbound	132.1	138.7	138.7	135.2	162.5	160.4	139.0	141.5	1.0
Outbound	--	24.0	16.4	16.4	--	1.7	--	--	--
Local	266.7	322.8	320.5	307.6	312.2	193.6	122.1	336.1	3.4
Distillate fuel oil	1,621.7	1,635.8	2,108.7	3,452.0	3,690.5	4,026.5	4,372.6	5,998.4	20.6
Inbound	795.5	845.3	1,095.2	1,396.3	1,620.5	1,666.4	2,107.1	2,440.6	17.4
Outbound	137.6	136.0	147.5	177.2	63.6	132.7	114.5	381.4	15.7
Local	688.6	654.5	866.0	1,878.5	2,006.4	2,227.4	2,151.0	3,176.4	24.4

(Continued)

Table 1. (Continued)

Commodity and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
<u>Residual fuel oil</u>	1,262.8	1,200.9	1,128.6	1,476.9	1,882.3	3,361.5	3,163.8	2,907.0	12.7
Inbound	222.0	333.0	494.9	739.2	1,503.4	2,474.0	1,893.9	1,711.8	33.9
Outbound	322.8	163.0	131.9	156.6	50.0	128.8	132.7	107.4	(14.5)
Local	718.0	704.9	501.8	581.1	328.9	758.7	1,137.2	1,087.8	6.1
<u>Liquefied gases</u>	372.2	371.2	438.0	448.1	470.2	172.9	143.1	178.9	(9.9)
Inbound	362.1	356.2	412.1	413.0	436.4	139.0	78.3	98.6	(17.0)
Outbound	1.0	4.2	10.7	17.3	24.4	20.9	29.5	55.3	77.4
Local	9.1	10.8	15.2	17.8	9.4	13.0	35.3	25.0	15.5

Note: Individual items may not add to totals due to rounding.

a. No tonnages reported in 1969.

Source: Compiled by RRNA from <u>Waterborne Commerce by Port Equivalents,</u> 1969-76, supplied by the U.S. Army Corps of Engineers.

Table 2. Ohio River Basin: Waterborne Commerce by BEA, 1976
Group II: Petroleum Fuels

(Thousands of tons)

		Destination													
Origin	Total	ORB BEAs	BEA 47	BEA 48	BEA 49	BEA 50	BEA 52	BEA 54	BEA 55	BEA 62	BEA 64	BEA 65	BEA 66	BEA 68	BEA 115
TOTAL	20943.4	19650.3	446.6	510.8	1326.7	37.8	3097.9	3988.3	1252.0	2144.6	718.4	295.0	4077.2	716.6	1038.4
ORB BEAs	12128.6	10835.5	119.0	148.0	107.1	--	2180.2	2060.8	390.0	1710.3	562.3	295.0	2179.1	441.2	642.5
BEA 47	56.1	13.1	--	--	--	--	8.0	--	--	--	--	--	5.1	--	--
BEA 49	10.0	10.0	--	--	10.0	--	--	--	--	--	--	--	--	--	--
BEA 52	4979.7	4933.8	--	--	2.0	--	1181.0	588.0	177.0	1067.0	329.8	--	1289.0	300.0	--
BEA 53	3.0	3.0	--	--	--	--	3.0	--	--	--	--	--	--	--	--
BEA 54	332.6	297.0	--	--	5.0	--	74.0	77.0	1.0	36.0	3.0	--	40.0	61.0	--
BEA 55	3398.2	2283.0	107.0	148.0	90.1	--	389.0	524.1	158.0	409.5	70.0	--	130.7	51.1	205.5
BEA 62	1854.5	1837.6	--	--	--	--	382.2	863.9	54.0	195.6	112.0	--	123.9	--	106.0
BEA 64	1.0	1.0	--	--	--	--	--	--	--	--	--	--	1.0	--	--
BEA 66	689.5	684.0	--	--	--	--	134.0	7.8	--	--	30.0	160.0	344.1	8.1	--
BEA 68	427.0	427.0	--	--	--	--	9.0	--	--	2.2	17.5	135.0	242.3	21.0	--
BEA 115	377.0	346.0	12.0	--	--	--	--	--	--	--	--	--	3.0	--	331.0
Non-ORB BEAs	8814.8	8814.8	327.6	362.8	1219.6	37.8	917.7	1927.5	862.0	434.3	156.1	--	1898.1	275.4	395.9
BEA 38	10.0	10.0	--	--	10.0	--	--	--	--	--	--	--	--	--	--
BEA 46	704.6	704.6	--	--	333.8	--	21.2	103.7	97.9	27.5	3.3	--	96.3	13.4	7.5
BEA 77	143.2	143.2	--	84.6	15.6	--	9.9	17.0	2.0	--	11.1	--	--	--	3.0
BEA 78	35.0	35.0	--	--	--	--	--	--	--	--	--	--	35.0	--	--
BEA 79	2.0	2.0	--	--	--	--	--	--	2.0	--	--	--	--	--	--
BEA 114	2189.0	2189.0	132.0	105.7	210.7	--	5.6	717.9	563.1	201.6	--	--	191.9	14.5	46.0
BEA 119	24.5	24.5	--	--	--	--	--	--	--	11.1	--	--	--	13.4	--
BEA 134	213.3	213.3	--	--	49.2	--	--	74.0	4.0	3.0	1.1	--	82.0	--	--
BEA 137	296.5	296.5	--	--	--	--	--	201.0	28.0	12.2	--	--	--	--	55.3
BEA 138	3997.5	3997.5	160.3	24.5	592.2	--	575.6	723.7	147.0	151.8	135.1	--	1099.1	107.1	281.1
BEA 139	2.2	2.2	--	--	--	--	--	--	--	--	2.2	--	--	--	--
BEA 140	417.2	417.2	22.0	110.2	--	37.8	111.4	7.2	--	27.1	--	--	86.5	12.0	3.0
BEA 141	724.7	724.7	13.0	37.8	7.0	--	150.0	77.0	18.0	--	3.3	--	303.3	115.0	--
BEA 143	54.0	54.0	--	--	--	--	44.0	6.0	--	--	--	--	4.0	--	--
BEA 144	1.1	1.1	--	--	1.1	--	--	--	--	--	--	--	--	--	--

(Continued)

Table 2 (Continued)

Origin	Non-ORB BEAs	BEA 46	BEA 57	BEA 77	BEA 78	BEA 79	BEA 114	BEA 115[a]	BEA 134	BEA 137	BEA 138	BEA 140	BEA 141
							Destination						
TOTAL	1293.1	508.7	21.0	130.3	117.0	50.0	274.3	8.9	2.2	8.9	103.8	25.0	43.0
ORB BEAS	1293.1	508.7	21.0	130.3	117.0	50.0	274.3	8.9	2.2	8.9	103.8	25.0	43.0
BEA 47	43.0	--	--	--	--	--	--	--	--	--	--	--	43.0
BEA 49	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 52	45.9	--	--	--	--	--	14.0	--	--	8.9	23.0	--	--
BEA 53	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 54	35.6	--	--	--	--	--	35.6	--	--	--	--	--	--
BEA 55	1115.2	500.7	21.0	127.0	117.0	50.0	224.7	3.3	2.2	--	67.3	2.0	--
BEA 62	16.9	--	--	--	--	--	--	5.6	--	--	11.3	--	--
BEA 64	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 66	5.5	--	--	3.3	--	--	--	--	--	--	2.2	--	--
BEA 68	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 115	31.0	8.0	--	--	--	--	--	--	--	--	--	23.0	--
Non-ORB BEAs													
BEA 38													
BEA 46													
BEA 77													
BEA 78													
BEA 79													
BEA 114													
BEA 119													
BEA 134		**Traffic external to Ohio River System**											
BEA 137													
BEA 138													
BEA 139													
BEA 140													
BEA 141													
BEA 143													
BEA 144													

a. Consists of counties external to Ohio River Basin.
Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

a. Inbound Movements

Most inbound movements originated in BEA 138 (New Orleans). In 1976, 3,997.5 thousand tons of petroleum fuels, nearly one-half of the inbound shipments, were shipped to the ORS from this BEA. The fuels were transported to large metropolitan areas in the ORB: BEA 66 (Pittsburgh) received 1,099.1 thousand tons; BEA 54 (Louisville), 723.7 thousand tons; BEA 49 (Nashville), 592.2 thousand tons. The remainder was distributed to nine other BEAs. The second largest shipping BEA of waterborne inbound movements in 1976 was BEA 114 (St. Louis), which transported 2,189.0 thousand tons of petroleum fuels to the ORB via the Mississippi, Tennessee and Ohio Rivers. Moreover, three-quarters of BEA 114 shipments went to BEAs 49 (Nashville), 54 (Louisville), 55 (Evansville), and 62 (Cincinnati).

b. Outbound Movements

Outbound movements of petroleum fuels amounted to 1,293.1 thousand tons in 1976 and accounted for over 6 percent of total petroleum fuels shipments. Although classified as outbound, most fuels moved only a short distance from BEA 55 (Evansville) to BEA 114 (St. Louis) and to the western part of BEA 46 (Memphis), just outside the ORB.

c. Local Movements

Local movements are large (10.8 million tons in 1976) and have been growing rapidly in the past decade. Most movements of this type originated from oil refineries in BEA 52 (Huntington) and BEA 55 (Evansville). The majority of petroleum fuels was distributed to the most densely populated BEAs along the Ohio River. BEA 66 (Pittsburgh) received one-fifth of the total petroleum fuels transported within the ORS. BEAs 52 (Huntington), 54 (Louisville) and 62 (Cincinnati) received similar shares.

d. Intermodal Transfer

There is little intermodal transfer between barge and rail, or barge and truck, for shipments from producers to regional distribution centers. However, there has been an increasing amount of petroleum fuels transported by barge from producing areas to BEAs 54 (Louisville) and 55 (Evansville). These shipments are then transferred to pipelines for distribution to other parts of the United States.

C. Summary of Study Findings

Petroleum fuels are consumed by nearly all sectors of the economy. Motor gasoline and jet fuels are used in the transportation sector. Other fuels are primarily used by the industrial sector to run machinery and by households, and other sectors, for heating. In 1976, the PSAs accounted for 6.1 percent of the U.S. demand for petroleum fuels but produced only 2.5 percent of fuel output. As a result, substantial amounts of domestic and imported fuels must be transported to the region. The largest amounts of fuels transported by barge to the ORS are from BEAs 138 (New Orleans) and 114 (St. Louis). Because of the complexity of distribution, some outbound transportation from the area served by the ORS has been observed; however, the outbound movements have been small.

The consumption of petroleum fuels in the PSAs is projected to increase rapidly until the year 2000. Thereafter, the crude oil shortage, coupled with the likelihood of increasing fuel availabilities from synthetic and other fuel sources, will result in a decrease in the consumption of petroleum fuels. Petroleum fuels production, on the other hand, will reach its peak in 1990. It will decline in following decades.

The waterborne transportation of petroleum fuels in the PSAs depends on the relationship of production and consumption within and among the BEAs as well as on the availability of pipelines. A new pipeline, completed in 1977 between Louisville, KY, and Robinson, IL, significantly altered the transportation patterns of petroleum fuels in the area served by the ORS. Inbound waterborne movements of petroleum fuels are projected to decrease from 8.8 million tons in 1976 to 4.9 million tons in 1990. The movements will increase in the 1990-2000 decade due to high consumption and low production in the PSAs. It will decrease in the following decades because of the expected decline in both production and consumption. Local movements will reach a peak in the mid-1990s and decrease thereafter to 6.8 million tons in 2040.

II. MARKET DEMAND ANALYSIS

Petroleum fuels, as energy sources, are consumed by nearly all sectors of the economy, both within and outside the Ohio River Basin.

A. Market Areas

In addition to local demand for Group II commodities produced in the PSAs, demand also is generated by Secondary Consumption Areas (SCAs) located outside the ORB. These SCAs are defined as BEAs which are the destinations of waterborne petroleum fuel movements originating in the Ohio River Basin.

A-1. Primary Study Areas (PSAs)

This study has identified 14 BEAs and BEA segments in the ORB which either have been or will be the ultimate origins or destinations of waterborne movements of Group II in the ORS.

Appendix Table A-1 and Appendix Map A-1 present the BEAs and BEA segments which constitute the PSAs for petroleum fuels and for which petroleum fuel consumption has been analyzed and projected.

The western portion of BEA 115 (Paducah) uses the Mississippi River rather than the ORS to transport petroleum fuels; therefore, only the eastern part of this BEA is included in the analysis and projection. Similarly, only two counties in BEA 68 (Cleveland) are included. Others are either located too far from the Ohio River or use the port of Cleveland to transport fuels. For all other BEAs, consumption was analyzed and projected for the BEA as a whole.

A-2. Secondary Consumption Areas (SCAs)

BEAs outside the Ohio River Basin which are destinations of waterborne shipments from the ORB were not segmented, nor was any attempt made to analyze or project consumption in these BEAs. Because of the low volume of historical and projected shipments from the ORB to Secondary Consumption Areas, such efforts were not warranted.

B. Product Uses

Petroleum fuels have a wide variety of uses. Generally, motor gasoline and jet fuels are consumed in the transportation sector, while other fuels are used in household and industrial sectors for heating or as a source of electricity generation.

B-1. Motor Gasoline and Jet Fuels

The Federal Highway Administration, in Highway Statistics, identified nine different uses of gasoline. These range from highway and agricultural uses to construction, marine and other miscellaneous uses. Jet fuels are used only in aviation. All of these uses are directly related to transportation. The percentage of gasoline used in heating and electricity generation is negligible.

B-2. Distillate Fuel Oil

Distillate fuel oil is a general classification of petroleum fuel consisting of fuel oils and diesel fuels.[1] In 1976, the United States consumed 3.3 million barrels per day of distillate fuel oil, as compared with 1 million barrels of jet fuel and 7.2 million barrels of gasoline. The latest available estimate (1974) shows that 49.6 percent of total distillate fuel oil was consumed by the residential-commercial sector, 36.7 percent by the transportation sector, and 12.7 percent by the industrial sector. The remaining 1 percent was consumed in miscellaneous uses.[2]

---

1. Including No. 1, No. 2 and No. 4 fuel oils, and No. 1-D and No. 2-D diesel fuels.
2. Oak Ridge National Laboratory, Energy Availabilities for State and Local Development: Projected Energy Patterns for 1980 and 1985 (Oak Ridge, TN: ORNL, 1978), Table 1.

B-3. Residual Fuel Oil

This group mainly includes No. 5 and No. 6 fuel oils. They are used primarily for heating, but some residual fuel oil is also used in transportation as fuel for locomotives and vessels. In 1974, the residential-commercial sector, industrial sector and transportation sector used 29.4 percent, 40.2 percent and 23.4 percent, respectively, of residual fuel oil consumption.[1]

B-4. Other Fuels

Other petroleum fuels are mostly used in the household and industrial sectors. Kerosine is a clean burning product which, when burned in wick lamps, is suitable for use as an illuminant. It is also used as heating oil. Ninety percent of liquefied petroleum gas (LPG) consumption is in the residential-commercial sector. Some is used as internal combustion engine fuel.

C. Consumption Characteristics

Consumption characteristics of petroleum fuels are determined by factors influencing fuel demand. These consumption characteristics can be separated into two categories: the general characteristics which apply to all fuels, and the specific characteristics which apply to particular types of fuels in different regions.

C-1. General Characteristics

The common factors influencing the demand for petroleum fuels are population, income, effectiveness of national energy conservation programs, long-term supply, technological elements, and/or the prices of substitute fuels.

Population and income have significant impacts on energy consumption in general and on petroleum consumption in particular. At the national level, the growth of population and income can be approximated by the rate of change in Gross National Product (GNP). The U.S. Department of Energy predicted that, for the 1975-85 period, a real GNP growth rate of 3.8 percent per year will likely be associated with an average annual growth rate of 2.6 percent in energy consumption. If a GNP growth rate of 4.2 percent is assumed, energy consumption growth would increase to 3.1 percent per

---

1. Ibid.

annum.[1] With an effective energy conservation program, the energy consumption would not increase at such a rapid rate.

The supply of crude oil and petroleum fuels also places a constraint upon energy consumption. In the short run, a low domestic supply of petroleum can be supplemented by imports. However, other things being equal, the resulting higher energy prices and a larger trade deficit will have a negative impact on the GNP growth and decrease the U.S. energy consumption. In the long run, the import of petroleum is expected to decrease as the world oil reserves are depleted. The oil shortage and high prices will encourage the use of coal, nuclear, solar and other energy sources. The supply of these energy sources is expected to increase as a result from new technologies, which are encouraged by the high costs of oil to meet the demand for energy. This demand-supply mechanism implies that, in the long run, the consumption of crude oil is strongly governed by the available supply.

C-2. Specific Characteristics

The demand for petroleum fuels also varies with the factors influencing the demand for particular fuels.

a. Motor Gasoline and Jet Fuels

Motor gasoline is used in transportation for all sectors. A shift in the relative sizes of these sectors would influence the consumption of gasoline. For example, agricultural consumption of gasoline depends on the growth of the agricultural sector, and; automobile consumption depends on automobile ownership, average gas mileage and emission standards. Unequal growth in these sectors would vary the rate of gasoline consumption, given the same GNP growth. Similarly, a percentage increase in automobile ownership would cause the consumption of gasoline to rise substantially higher than would a percentage increase in air and marine transportation.

b. Distillate Fuel Oil

Distillate fuel oil is used in residential and commercial heating, in industrial plants, and in the transportation sector.

1. U.S. Department of Energy, Energy Information Administration, Annual Report to Congress, 1977 ed. (Washington, D.C.: GPO, 1978), Vol. II.

More distillate fuel oil is needed for heating during winter months and in colder years. The residential and commercial sector shares account for one-half of the total consumption of distillate fuel oil. If these sectors have growth which differs between regions, or if their shares change over time, then the demand for distillate fuels, oil will be significantly changed.

c. Residual Fuel Oil

Although a larger consumption share of residual fuel oil goes to the industrial sectors than to residential-commercial sector, the demand for this fuel is influenced by factors similar to those influencing distillate fuel oil.

D. Existing Aggregate Demand

In 1976, the United States consumed 2,567 million barrels of gasoline. This represented a 4 percent increase over consumption in 1975. Three hundred sixty-one million barrels of jet fuel, 1,146 million barrels of distillate fuel oil, and 1,020 million barrels of residual fuel oil also were consumed. In terms of British thermal units (Btus), gasoline consumption accounted for 46 percent of the total U.S. energy consumption of petroleum; jet fuel consumption accounted for 7 percent, and; distillate fuel oil, residual fuel oil and other products for the remainder.[1] Petroleum fuel, as a group, accounted for two-fifths of total national energy consumption.

In the PSAs, petroleum fuel consumption was estimated at 47,592.3 thousand tons in 1976, approximately 6.1 percent of the national consumption (Table 3).[2] Gasoline, distillate fuel oil and residual fuel oil accounted for 94 percent of the total petroleum fuel tonnage consumed. BEA 66 (Pittsburgh), with a large population and a large industrial base, accounted for 25 percent of the total fuel consumption in the PSAs. Except for BEAs 65 (Clarksburg), 68 (Cleveland) and 115 (Paducah), which each consumed less

---

1. U.S. Department of Energy, Office of Policy Analysis, Executive Summary, Vol. I of Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000, Draft Report (Washington, D.C.: GPO, 1979), Table 2-3.

2. Conversion factors are as follows: gasoline, 7.742 barrel per ton (bpt), 5,248,000 Btus per barrel (Bpb); distillate fuel oil, 6.729 bpt, 5,825,000 Bpb; residual fuel oil, 5.718 bpt, 6,287,000 Bpb; kerosene and jet fuels, 7.013 bpt, 5,670,000 Bpb.

Table 3. United States and Ohio River Basin: Consumption of Petroleum Fuels, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
United States	616,597.1	645,299.7	670,395.8	726,090.5	764,666.4	725,853.7	717,590.9	774,818.9
Primary Study Areas	36,518.8	38,201.1	38,981.7	42,488.1	44,197.8	43,670.2	43,254.5	47,592.3
BEA 47: Huntsville, AL	1,416.5	1,504.3	1,555.4	1,752.1	1,954.4	1,955.0	2,007.3	2,276.5
BEA 48: Chattanooga, TN	1,636.8	1,708.6	1,812.9	2,018.6	2,284.4	2,198.5	2,202.1	2,420.1
BEA 49: Nashville, TN	2,974.7	3,083.0	3,217.4	3,553.2	3,955.9	3,887.3	4,100.5	4,529.6
BEA 50: Knoxville, TN	1,913.8	1,972.5	2,075.0	2,276.0	2,528.4	2,466.4	2,590.9	2,867.7
BEA 52: Huntington, WV	2,491.8	2,611.7	2,631.9	2,930.3	3,045.1	3,098.6	3,216.0	3,517.5
BEA 53: Lexington, KY	1,615.5	1,675.7	1,692.4	1,842.1	1,956.8	1,963.5	2,007.5	2,204.2
BEA 54: Louisville, KY	2,930.0	2,998.7	3,032.7	3,265.7	3,425.4	3,410.5	3,418.9	3,662.5
BEA 55: Evansville, IN	2,050.8	2,102.1	2,192.4	2,376.2	2,425.9	2,348.5	2,313.5	2,485.9
BEA 62: Cincinnati, OH	4,195.2	4,218.8	4,272.4	4,641.5	4,814.3	4,733.6	4,778.1	5,210.0
BEA 64: Columbus, OH	3,504.5	3,617.3	3,647.2	4,042.0	4,158.8	4,054.3	4,213.9	4,634.4
BEA 65: Clarksburg, WV	448.3	475.6	477.5	539.0	562.3	565.2	586.3	629.1
BEA 66: Pittsburgh, PA	10,688.9	11,433.8	11,528.5	12,325.2	12,137.4	11,999.1	10,859.2	12,118.4
BEA 68: Cleveland, OH	261.3	264.5	267.8	292.4	304.0	294.5	305.4	336.8
BEA 115: Paducah, KY	480.7	534.5	578.2	633.8	644.7	655.2	654.4	699.6

Note: State consumption data for petroleum fuels were obtained by major use from the Bureau of Mines and the Department of Energy. Fuels consumed in household, commercial, and transportation uses were distributed among BEAs and BEA segments on the basis of population distribution. Fuels consumed in industrial uses were distributed among BEAs and BEA segments on the basis of manufacturing employment, except for liquefied petroleum gases used in the manufacture of chemicals, which were distributed on the basis of 1970 distribution of chemical employment. Fuels used in miscellaneous uses were distributed among BEAs and BEA segments on the basis of other petroleum fuel distribution.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. and state consumption from U.S. Department of the Interior, Bureau of Mines, Historical Fuels and Energy Consumption Data, 1960-72, United States and Census Districts East of the Mississippi; Fuels and Energy Data: United States by States and Census Divisions, 1973, 1974; "Crude Petroleum and Petroleum Products," Minerals Yearbook, 1976 ed.; and from U.S. Department of Energy, "Sales of Fuel Oil and Kerosine in 1976" and "Sales of Liquefied Petroleum Gases and Ethane in 1976," Energy Data Reports. Population and manufacturing employment data provided by the U.S. Department of Commerce, Bureau of Economic Analysis, and from the U.S. Bureau of Labor Statistics, Employment and Earnings, United States 1966-75.

than 700 thousand tons in 1976, petroleum fuel consumption is relatively equally distributed among the BEAs in the area served by the ORS.

From 1969 to 1976, petroleum fuel consumption in the PSAs grew 30 percent, compared to the 26 percent growth experienced by the nation.

E. Forecasting Procedures and Assumptions

Numerous projections of petroleum fuel production and consumption have been made by individuals, research institutions and government agencies. All have forecasted demand for energy in terms of Btus and have then allocated it to various energy sources, including coal, petroleum, nuclear, hydroelectric, etc. Few projections have been made for state or local areas.

The most notable U.S. projections are those of the U.S. Department of Energy, Energy Information Administration (EIA).[1] EIA projections are generally accepted as the official energy projections for the United States.

EIA projection procedures are aimed at providing a general energy forecast which encompasses differing viewpoints. Various projections were developed using different rates of national economic growth, different levels of recoverable energy resources, and changes in the real price of imported oil.

Short-run projections by EIA consider three possible levels of economic growth, based on forecasts provided by Data Resources, Inc. (DRI). For the mid-term high, low and medium projections (to 1985 and 1990), the DRI forecasts were incorporated into the Project Independence Evaluation System (PIES)[2] to obtain the basic national level projections associated with three assumed levels of

---

1. U.S. Department of Energy, Energy Information Administration, Annual Report to Congress, 1977 ed. (Washington, D.C.: GPO, 1977), Vol. II.
2. The PIES is a model of the technologies, costs and geographical locations which affect energy commodities from the point of discovery through production, transportation, conversion to more useful forms, and ultimately consumption by all sectors of the economy (see Federal Energy Administration, "Appendix A," National Energy Outlook, Washington, D.C.: GPO, 1976).

energy supply (Table 4). The EIA medium projection (Series C) was selected to forecast the consumption of crude oil and petroleum fuels in the area served by the ORS.[1]

The U.S. national projection of petroleum fuels consumption by types of fuels was then distributed to the PSAs. This projection was based on projections from two different sources.

Oak Ridge National Laboratory (ORNL), in a report published in June 1978, developed projections to 1980 and 1985 of energy supply and demand patterns in the United States, for each of the nine census regions, 50 states and 173 BEAs.[2] The supply and demand projections were made for seven fuel types and four final consuming sectors.[3] ORNL selected the "business as usual" scenario projected by the Federal Energy Administration in the 1976 National Energy Outlook. The distribution procedure used historical and forecasted regional characteristics to allocate production and consumption totals estimated at the national level. Projected regional economic and demographic characteristics were based on OBERS projections. Energy consumption characteristics for each BEA were assumed to be determined by the BEA's share of the overall state level of activity. Additional variables were assumed to be either uniform across the state (e.g., heating degree days) or unimportant relative to differences in the level of activity (e.g., per capita income or regional price differences).[4]

An apparent shortcoming of the Oak Ridge report, with respect to this study, is that the U.S. energy projections were derived from the National Energy Outlook, and these projections were revised in the 1977 Annual Report to Congress. Therefore, to

---

1. For additional information on EIA projection methodology, see Ibid, pp. xv-xl.
2. Oak Ridge National Laboratory, Energy Availabilities for State and Local Development: Projected Energy Patterns for 1980 and 1985 (Oak Ridge, TN: ORNL, 1978).
3. Seven fuel types are crude oil, distillate oil, residual oil, gasoline, other hydrocarbons, natural gas and coal. Four final demand sectors include residential and commercial, industrial, transportation and miscellaneous uses.
4. Oak Ridge National Laboratory, Energy Availabilities for State and Local Development: A Methodology and Data Overview (Oak Ridge, TN: ORNL, 1978), p. 25.

Table 4. National Energy Consumption Projections under Alternative Assumptions

(Average annual percentage change)

Projection series assumption		Gross national product			Energy consumption		
Economic growth	Energy supply	Actual 1965-1975	Projected 1975-1985	Projected 1985-1990	Actual 1965-1975	Projected 1975-1985	Projected 1985-1990
A. High	High	2.6	4.3	3.0	2.8	3.2	2.5
B. High	Low	2.6	4.2	3.0	2.8	3.1	2.4
C. Medium	Medium	2.6	4.1	3.2[a]	2.8	3.0	2.8
D. Low	High	2.6	3.9	2.6	2.8	2.7	2.0
E. Low	Low	2.6	3.8	2.5	2.8	2.6	2.0

a. The growth rate for GNP is greater than that projected for 1985-90 in the other scenarios. However, for the entire period 1975-90, the overall growth projected falls in the medium range.

Source: U.S. Department of Energy, Energy Information Administration, Annual Report to Congress, Volume II, 1977, p. xix.

incorporate the revisions in this study, projections were developed from the latest national data as recorded in the Annual Report, while regional allocation factors were provided by Oak Ridge to estimate the BEA consumptions of petroleum fuels in 1980. The major drawback of this approach is that it does not account for the possible effects of higher energy consumption which could result in shifts in the Oak Ridge regional distribution. However, to determine these shifts would require substantial theoretical and computer work in cooperation with the ORNL. This process probably would yield only minimal impacts on the projections of ORS waterborne Group II movements.

The consumption of gasoline, distillate fuel oil and residual fuel oil accounts for nearly 95 percent of the total consumption of petroleum fuels. The projected growth in consumption of these fuels, therefore, yields a reliable estimate of the growth of the group as a whole.[1]

Using the Annual Report and Oak Ridge projections, the growth rates of consumption of gasoline, distillate fuel oil and residual fuel oil by BEAs (which are assumed to equal the growth rates of all petroleum fuels consumption) for the 1976-80 period were estimated. These growth rates were applied to the appropriate PSAs to obtain the 1980 petroleum fuels consumption projections. The 1990 and 2000 estimates were projected by using the same methods and by applying the 1985 BEA allocation factors. Beyond the year 2000, since reduced supplies of fuels are expected to influence consumption, consumption by PSA was assumed to decrease at a rate equal to two-thirds of the change estimated for petroleum fuel production.

F. Probable Future Demand

As discussed above, a significant factor which might influence future demand for petroleum fuels is the national energy conservation program. Such a program has been planned since 1974, following the Arab oil embargo. However, so far little progress has been made in reducing the nation's dependency on petroleum. The effectiveness of this program in the future remains uncertain.

---

1. Projections of the consumption of these three types of fuels for 1980 and 1985 are available at the BEA level in the Oak Ridge report.

The other factor which influences the consumption of petroleum fuels is their available supply, or the available crude oil for refineries. Because of decreasing reserves, crude oil supply in the United States and in the PSAs is expected to decline in the mid-1990s. The declining rate will likely accelerate in the following decades. Even with increased imports of crude oil and petroleum products, the total available supply will decrease. This will, therefore, reduce the consumption of fuels.

In the PSAs, consumption of petroleum is projected to follow past trends and increase rapidly until 1990. Consumption will rise at a slower rate beginning in 1990 and then decline in absolute amounts by the turn of the century. The average annual growth rates are estimated to be 1.62 percent for 1976-90 and -0.34 percent for 1976-2040 (Table 5). BEA 66 (Pittsburgh) will continue to be the major consuming area, while BEAs 68 (Cleveland), BEA 65 (Clarksburg) and 115 (Paducah) will be the least significant PSAs.

Table 5. Ohio River Basin: Consumption of Petroleum Fuels by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	Projected 1990	Projected 2000	Projected 2020	Projected 2040	Average annual percentage change 1976-90	Average annual percentage change 1976-2040
Primary Study Areas	47,592.3	48,895.8	59,621.3	64,826.8	54,249.7	38,188.3	1.62	(0.34)
BEA 47: Huntsville, AL	2,276.5	2,328.9	2,909.3	3,101.9	2,593.2	1,810.0	1.77	(0.36)
BEA 48: Chattanooga, TN	2,420.1	2,582.4	3,178.9	3,395.7	2,838.8	1,981.5	1.97	(0.31)
BEA 49: Nashville, TN	4,529.6	4,813.3	5,948.4	6,417.1	5,364.7	3,744.6	1.97	(0.30)
BEA 50: Knoxville, TN	2,867.7	3,019.6	3,602.3	3,875.4	3,293.8	2,261.4	1.64	(0.37)
BEA 52: Huntington, WV	3,517.5	3,312.0	3,687.6	4,013.6	3,355.4	2,342.1	0.34	(0.63)
BEA 53: Lexington, KY	2,204.2	2,227.3	2,693.8	2,837.1	2,371.8	1,655.5	1.44	(0.45)
BEA 54: Louisville, KY	3,662.5	3,846.2	4,753.2	5,165.8	4,318.6	3,014.4	1.88	(0.30)
BEA 55: Evansville, IN	2,485.9	2,691.8	3,284.5	3,611.6	3,019.3	2,107.5	2.01	(0.26)
BEA 62: Cincinnati, OH	5,210.0	5,479.3	6,581.7	7,126.7	5,957.9	4,518.6	1.68	(0.22)
BEA 64: Columbus, OH	4,634.4	4,806.8	6,397.5	6,996.3	5,848.9	4,082.5	2.33	(0.20)
BEA 65: Clarksburg, WV	629.1	574.9	672.5	728.2	608.8	424.9	0.48	(0.61)
BEA 66: Pittsburgh, PA	12,118.4	12,138.8	14,638.3	16,188.5	13,533.6	9,446.5	1.36	(0.39)
BEA 68: Cleveland, OH	336.8	335.8	394.7	425.9	356.1	248.5	1.14	(0.47)
BEA 115: Paducah, KY	699.6	738.7	878.6	943.0	788.4	550.3	1.64	(0.37)

Note: The consumption of petroleum fuels for 1980 is projected based on the annual growth rates of the BEAs for the 1974-80 period of the sum of gasoline, distillate and residual fuel oils, provided in the Oak Ridge report, adjusted for the latest projections made by the U.S. Department of Energy (DOE). The 1990 and 2000 projections are derived from the national consumption estimated by DOE and distributed to the BEAs by 1985 allocation factors provided by Oak Ridge. The rates of consumption change in the later decades are assumed to be two-thirds of the rates of change of petroleum fuel production.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Energy, Energy Information Administration, Annual Report to Congress, Vol. II, 1977 ed; Oak Ridge National Laboratory, Energy Availabilities for State and Local Development: Projected Energy Patterns for 1980 and 1985, June 1978; and Table 3.

III. COMMODITY RESOURCES INVENTORY

Production of petroleum fuels in the PSAs increased from 14,096.3 thousand tons to 15,941.3 thousand tons during the period 1969-76, an average annual increase of 1.47 percent. Through the year 2000, production in the PSAs is projected to increase at a higher annual rate, 3.17 percent. For the entire projection period 1976-2040, however, a decrease in production is projected. This decrease will be represented by an average annual decline of 0.69 percent.

A. Production Areas

The production of Group II commodities in the PSAs is supplemented by production in Secondary Production Areas (SPAs) located outside the Ohio River Basin. These SPAs are defined as BEAs which are the origins of Group II waterborne movements destined to the Ohio River Basin.

Since the PSAs do not produce sufficient crude oil for refineries in the area, substantial amounts of petroleum fuels have been shipped into the region. There are 16 BEAs outside the ORB which are SPAs. The major SPAs include BEA 138 (New Orleans) and BEA 114 (St. Louis). In 1976, these two BEAs shipped 4.0 million tons and 2.2 million tons, respectively, to the ORS. Together, they accounted for 70 percent of all inbound waterborne shipments of Group II.

B. Production Characteristics

The production characteristics of petroleum fuels are determined by factors influencing the supply of the commodities in the group. The supply of these commodities in the long run depends on the consumption of crude oil by refineries as well as technological factors. The consumption of crude oil is discussed in the Crude Petroleum (Group III) Report.

In recent years, technological development in refining has contributed significantly to the production of petroleum fuels and products. Refineries are using new procedures and processes to refine lower-quality oil into desired products. Products of high demand, such as gasoline, are being extended by adding methanol. Gulf Oil Corporation and Mobil Oil Corporation are developing new technologies which would permit refiners to produce a larger percentage of more valuable fuels from crude oil. While such new technologies will likely result in more Btus yielded per unit of crude oil, they do not significantly add to the weight (tonnage) of the products.[1]

C. Existing Production Levels

In 1976, oil refineries in the United States processed 4.9 billion barrels, or 746 million tons, of which 61 percent was domestic crude oil and lease condensate, and 39 percent originated in foreign countries.[2] The refinery output included 2.5 billion barrels of gasoline, 336 million barrels of jet fuels, 1.1 million barrels of distillate fuel oil, 504 million barrels of residual fuel oil and approximately 250 million barrels of other fuels.

Operable refinery capacity in the United States at year-end 1976 was reported at 16.4 million barrels per day (bpd). This was up 10 percent from year-end 1975. Gasoline output continued to account for about one-half of the production. Standard Oil Company, Shell Oil Co., Exxon Corporation and Texaco are major refiners in the United States. Exxon's 510,000 bpd plant in Baton Rouge, LA, the largest in the country, provides significant amounts of fuels to the PSAs.[3]

Unlike the rapidly increasing consumption, the production of petroleum fuels in the PSAs did not increase significantly in the past decade. As a matter of fact, production remained almost constant (around 14 million tons annually) during the 1969-73 period (Table 6). Beginning in 1974, the PSAs have experienced a fluctuating but slightly increasing trend in production. The largest amounts were produced by refineries in BEAs 52 (Huntington)

---

1. U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook, 1976 ed. (Washington, D.C.: GPO, 1979).
2. Ibid., p. 6.
3. For discussions on refineries in the PSAs, see Appendix B.

Table 6. United States and Ohio River Basin: Production of Petroleum Fuels, BEAs or BEA Segments[a], Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
United States	497,678.2	519,470.1	535,085.2	560,871.1	598,922.2	574,035.8	591,581.7	635,320.9
Primary Study Areas	14,096.3	13,880.4	13,680.8	14,076.1	14,570.0	15,156.8	16,376.9	15,841.7
BEA 47: Huntsville, AL	--	--	--	--	--	--	--	--
BEA 48: Chattanooga, TN	--	--	--	--	--	--	--	--
BEA 49: Nashville, TN	--	--	--	--	--	--	--	--
BEA 50: Knoxville, TN	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	4,366.9	4,918.3	5,518.5	5,261.6	5,068.3	5,147.3	5,695.0	5,536.7
BEA 53: Lexington, KY	--	--	--	--	--	--	106.0	125.4
BEA 54: Louisville, KY	768.0	825.1	989.3	1,050.2	984.8	994.6	1,177.0	1,035.0
BEA 55: Evansville, IN	5,738.0	5,312.4	4,707.6	4,852.9	5,495.0	5,819.2	6,089.1	5,842.0
BEA 62: Cincinnati, OH	2,387.0	2,345.7	2,361.9	2,691.0	2,625.7	2,671.7	2,861.5	2,845.7
BEA 64: Columbus, OH	836.4	478.9	103.5	124.2	125.1	174.3	170.5	146.3
BEA 65: Clarksburg, WV	--	--	--	--	--	--	--	--
BEA 66: Pittsburgh, PA	--	--	--	96.2	271.1	349.7	337.8	310.6
BEA 68: Cleveland, OH	--	--	--	--	--	--	--	--
BEA 115: Paducah, KY	--	--	--	--	--	--	--	--

Note: Production by BEA and BEA segment based on the ratio of district total fuel output to motor gasoline multiplied by production of motor gasoline by BEA and BEA segment. Production of motor gasoline by BEA and BEA segment based on state motor gasoline figures distributed among BEAs and BEA segment on the basis of the 1969-76 distribution of state gasoline production capacity of operating plants among BEAs and BEA segments. Annual distribution was estimated as the average of distributions obtained for January 1 of each year and the following year. Distribution of capacity in 1969 assumed equal to January 1, 1979 distribution.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Interior, Bureau of Mines, "Crude Petroleum and Petroleum Products," Minerals Yearbook, 1969-76 eds., and from U.S. Department of Interior, Bureau of Mines, "Petroleum Refineries in the United States and Puerto Rico," Mineral Industry Surveys, January 1, 1970-76.

and 55 (Evansville). In 1976, these two BEAs together accounted for 72 percent of the PSA production of petroleum fuels.

D. Forecasting Procedures and Assumptions

As discussed above, new technologies are not expected to significantly affect the tonnage of petroleum fuels derived from a ton of refined crude oil. Projections of production of petroleum fuels in each BEA have the same growth rates for production as for crude oil consumption in the same BEA. The projected consumption of crude oil for each BEA is presented in the Crude Petroleum (Group III) Report.

E. Probable Future Supply

The supply of petroleum fuels in the PSAs is projected to grow at an average annual rate of 3.17 percent from 1976 to 1990. This will represent 24.5 million tons in 1990 (Table 7). As a result of the limited supply of domestic crude oil and high import prices, the annual amounts of crude oil refined and petroleum fuels produced in the PSAs will decrease slightly by the year 2000. The rate of decline will accelerate in later decades and will cause the petroleum fuels supply to decrease to 10 million tons by 2040.[1] The rate of decrease for the entire 1976-2040 projection period is 0.69 percent per year.

The supply of petroleum fuels is projected to decrease most rapidly in BEAs 66 (Pittsburgh) and 64 (Columbus). These two BEAs are expected to experience a decrease in fuel production as early as the 1980s. Because of their access to crude oil pipelines, the major producing PSAs, BEAs 52 (Huntington) and 55 (Evansville), will experience a less rapid rate of decline over the 1976-2040 period. However, their shares of total production in the PSAs will not change significantly.

---

1. This acceleration of the declining rate of crude oil production will result in a total exhaustion of crude oil supply by the year 2100. This point of view is generally held by energy officials and industrial authorities.

Table 7. Ohio River Basin: Production of Petroleum Fuels by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons, unless otherwise indicated)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-90	1976-2040
Primary Study Areas	15,841.7	18,162.3	24,509.0	22,916.0	17,530.7	10,202.9	3.17	(0.69)
BEA 47: Huntsville, AL	--	--	--	--	--	--	--	--
BEA 48: Chattanooga, TN	--	--	--	--	--	--	--	--
BEA 49: Nashville, TN	--	--	--	--	--	--	--	--
BEA 50: Knoxville, TN	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	5,536.7	6,377.4	8,688.3	8,123.6	6,214.6	3,616.9	3.27	(0.66)
BEA 53: Lexington, KY	125.4	--	--	--	--	--	--	--
BEA 54: Louisville, KY	1,035.0	1,165.3	1,662.9	1,554.8	1,189.4	692.2	3.44	(0.63)
BEA 55: Evansville, IN	5,842.0	6,590.4	9,287.2	8,683.5	6,642.9	3,866.2	3.37	(0.64)
BEA 62: Cincinnati, OH	2,845.7	3,179.8	4,546.5	4,251.0	3,252.0	1,892.7	3.40	(0.64)
BEA 64: Columbus, OH	146.3	302.9	103.6	96.9	74.1	43.1	(2.44)	(1.89)
BEA 65: Clarksburg, WV	--	--	--	--	--	--	--	--
BEA 66: Pittsburgh, PA	310.6	546.3	220.5	206.2	157.7	91.8	(2.42)	(1.89)
BEA 68: Cleveland, OH	--	--	--	--	--	--	--	--
BEA 115: Paducah, KY	--	--	--	--	--	--	--	--

Note: The production estimates for each BEA or BEA segment are computed by multiplying the 1976 estimates by the appropriate growth rates of crude petroleum consumption.
a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.
Source: Table 6, and Crude Petroleum (Group III) Report.

IV. TRANSPORTATION CHARACTERISTICS

In the United States, most petroleum fuels consumed are shipped via pipeline. This pattern exists, to a lesser extent, in the Primary Study Areas. For the most part, water transport is used to ship fuels to BEAs which do not have pipeline connections from points along the Mississippi River or from areas served by the ORS which are either production centers or are supplied by pipeline.

A. Existing and Historical Modal Split

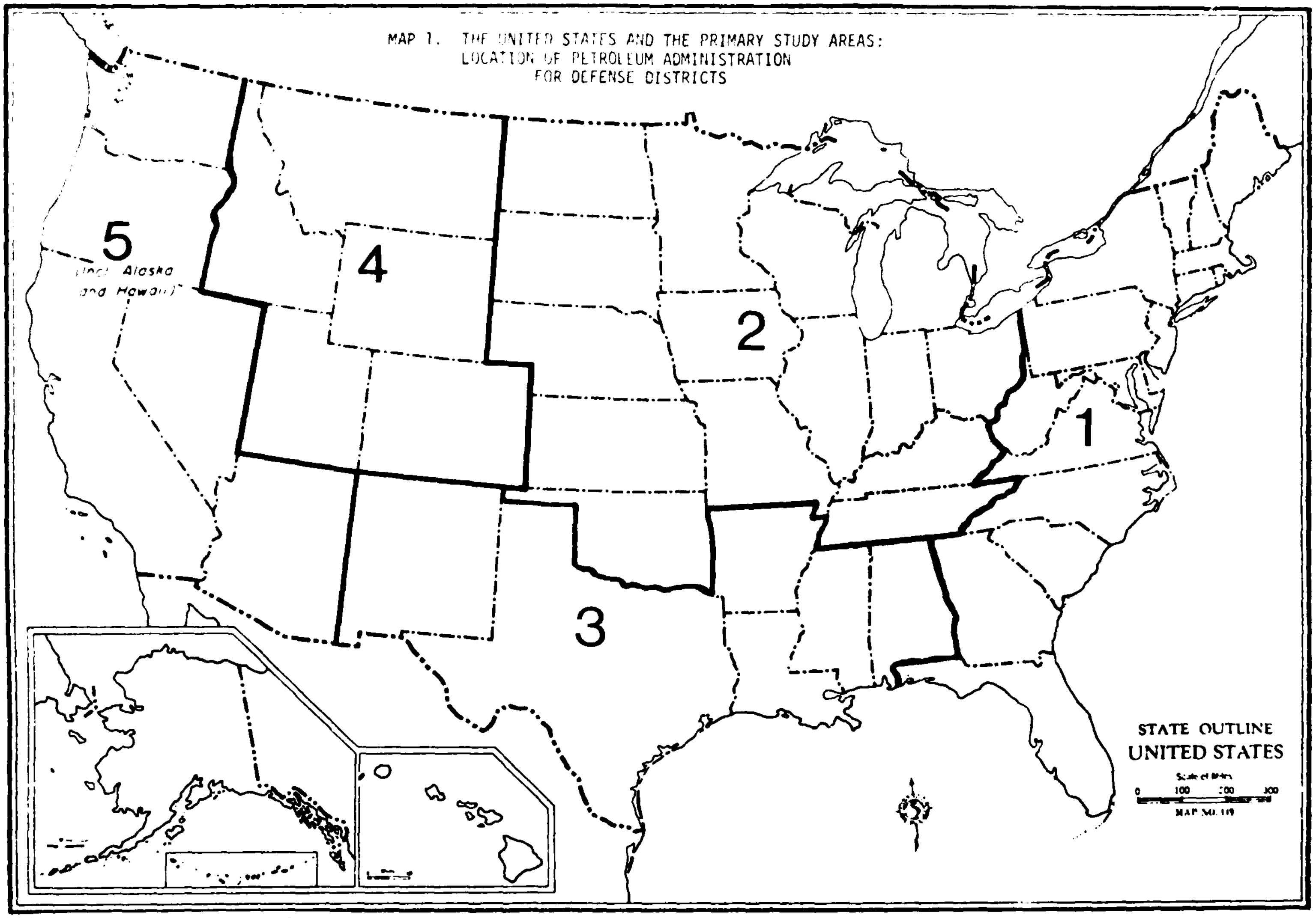
In 1976, 3.6 billion barrels of the total 5.5 billion barrels of petroleum fuels consumed in the United States were moved by pipeline. Rail, tank truck, barge and marine tankers share the remaining 1.9 billion barrels. Crude oil pipelines cannot be used to transport gasoline and other petroleum products. Product pipelines transport only light products, such as gasoline, light fuel oils, heating oils, liquid petroleum gas, kerosine and jet fuels.

Currently, the DOE provides no data on interstate movements of petroleum fuels by mode of transportation. However, the data on interdistrict movements do provide some information on refineries in the ORB. Most of Ohio River Basin falls within the Petroleum Administration for Defense District (PADD) II (Map 1). In 1976, there were 168 million barrels of petroleum fuels transported to PADD II from PADD III (Alabama, Arkansas, Louisiana, Mississippi, New Mexico and Texas), of which only 51 million barrels were transported to PADD II by water. The ratio of waterborne receipts to pipeline receipts is 30 percent. This is substantially larger than for other PADDs due to the convenient river systems flowing through the ORB.[1]

---

1. U.S. Department of Energy, Mineral Industry Survey: Crude Petroleum, Petroleum Products, and Natural Gas Liquids, 1976 ed. (Washington, D.C.: Bureau of Mines, 1976), p. 30.

MAP 1. THE UNITED STATES AND THE PRIMARY STUDY AREAS:
LOCATION OF PETROLEUM ADMINISTRATION
FOR DEFENSE DISTRICTS



Source: U.S. Department of Energy, Energy Data Report: Crude Petroleum, Petroleum Products, and Natural Gas Liquids, 1976 ed.

Primary Study Areas

A net total of 31.8 million tons of petroleum fuels was moved into the PSAs in 1976. More than 7.5 million tons of this total, or 24 percent, were contributed by waterborne shipments. Rail transportation accounted for only 1.3 percent. Pipeline and truck accounted for the bulk, 67.8 percent (Table 8).

The significance of waterborne shipments, relative to the net total shipments for a particular PSA, depends to a large extent on the availability of a products pipeline. This is clearly demonstrated by the modal splits of BEAs 52 (Huntington) and 55 (Evansville). In BEA 55, where there is a products pipeline, the 1976 net waterborne movement accounted for 39 percent of the total net shipments. On the other hand, BEA 52 has no products pipeline and is reported to have received 94 percent of net shipments by barge. The implication is that pipeline transportation of petroleum fuels is preferred to barge.[1]

B. Factors Affecting Modal Choice

The discussion above indicates the superiority of pipeline transportation of petroleum fuels as compared with barge, and most likely, other modes. The timeliness and low cost of pipeline deliveries are the main reasons.

B-1. Transport Time

Pipeline can transport petroleum directly from the production to consumption sources. Discussions with industrial authorities reveal that pipeline deliveries are almost always on schedule (usually to the minute). Barge transportation, on the other hand, is dependent on weather conditions, the river's water level, and other factors which cause considerable fluctuation in delivery times. As a result, refineries and petroleum product distributors are required to have larger and more costly storage facilities to avoid idle capacity due to delivery delays.

B-2. Transport Cost

Truck transportation of petroleum fuels and products currently costs between $0.47 and $0.65 per 100 miles per barrel compared with $0.02 to $0.10 per 100 miles per barrel shipped by products pipeline.[2] Because of high costs, trucks are often used to provide

---

1. For additional discussion on pipelines, see Appendix B.

2. U.S. Department of Energy, Executive Summary, Vol. I of Petroleum Supply Alternatives for Northern Tier and Inbound States Through the Year 2000, Draft Report (Washington, D.C.: GPO, 1979), p. 3-53.

Table 8. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Petroleum Fuels, by BEAs or BEA Segments,[a] Estimated 1976

(Thousands of tons)

BEA and BEA segment	Production	Consumption	Shipments (receipts)									
				Water				Rail				
			Total net	Net	Inbound	Outbound	Local	Net	Inbound	Outbound	Local	Net pipeline[b]
Primary Study Areas	15,841.7	47,592.3	(31,750.6)	(7,521.7)	8,814.8[c]	1,293.1[c]	10,835.5[c]	(433.4)	864.6	431.2[c]	53.7[c]	(23,795.5)
BEA 47: Huntsville, AL	--	2,276.5	(2,276.5)	(390.5)	446.6	56.1	--	(101.6)	101.6	--	--	(1,784.4)
BEA 48: Chattanooga, TN	--	2,420.1	(2,420.2)	(510.8)	510.8	--	--	(34.4)	34.4	--	--	(1,874.9)
BEA 49: Nashville, TN	--	4,529.6	(4,529.6)	(1,316.7)	1,316.7	--	10.0	(89.4)	89.4	--	--	(3,123.5)
BEA 50: Knoxville, TN	--	2,867.7	(2,867.7)	(37.8)	37.8	--	--	(53.0)	56.7	3.7	--	(2,776.9)
BEA 52: Huntington, WV	5,536.7	3,517.5	2,019.2	(1,881.8)	1,916.9	3,798.7	1,181.0	84.3	104.3	188.6	17.3	53.1
BEA 53: Lexington, KY	125.4	2,204.2	(2,078.8)	3.0	--	3.0	--	(24.6)	24.6	--	--	(2,057.2)
BEA 54: Louisville, KY	1,035.0	3,662.5	(2,627.5)	(3,655.7)	3,911.3	255.6	77.0	(45.2)	69.1	23.9	--	1,073.4
BEA 55: Evansville, IN	5,842.0	2,485.9	3,356.1	2,146.2	1,094.0	3,240.2	158.0	(124.8)	146.8	22.0	--	1,334.7
BEA 62: Cincinnati, OH	2,845.7	5,210.0	(2,364.3)	(290.1)	1,949.0	1,658.9	195.6	(23.5)	64.2	40.7	--	(2,050.7)
BEA 64: Columbus, OH	146.3	4,634.4	(4,488.1)	(717.4)	718.4	1.0	--	(13.9)	38.1	24.2	--	(3,756.8)
BEA 65: Clarksburg, WV	--	629.1	(629.1)	(295.0)	295.0	--	--	--	--	--	--	(334.1)
BEA 66: Pittsburgh, PA	310.6	12,118.4	(11,807.8)	(3,387.7)	3,733.1	345.4	344.1	(29.5)	163.8	134.3	--	(8,390.6)
BEA 68: Cleveland, OH	--	336.8	(336.8)	(289.6)	695.6	406.0	21.0	--	--	--	--	(47.2)
BEA 115: Paducah, KY	--	699.6	(699.6)	(661.4)	707.4	46.0	331.0	22.2	7.9	30.1	--	(60.4)

Note: Gross and net waterborne and rail shipments (receipts) were determined for 1976 from U.S. Army Corps of Engineers waterborne commerce data and Interstate Commerce Commission railroad waybill data. Total net shipments (receipts) were determined by subtracting consumption from production. Net pipeline shipments (receipts) were determined by subtracting net waterborne and rail shipments (receipts) from total net shipments (receipts).

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

b. Includes truck.

c. Total Primary Study Area shipments equal inbound, outbound, and local shipments for the Basin as a unit and do not equal the sum of shipments reported for each of the BEAs and BEA segments.

Source: Estimated production and consumption from Tables 3 and 6. Water and rail shipments (receipts) compiled by RRNA from Waterborne Commerce by Port Equivalents, revised 1976, and ICC Railroad Waybill Sample, 1976, supplied by the U.S. Army Corps of Engineers.

direct deliveries from refineries to distributors which are only short-distances apart. Occasionally, truck and barge (which costs about $0.20 per 100 miles per barrel) are used when products pipelines are at or near capacity utilization to provide additional products for peak seasonal demands.

Pipelines are not always available to transport petroleum fuels. They are highly capital intensive, and the large investment requirement requires a large volume of throughput in order for the pipeline to be profitable.[1] Areas producing and consuming small amounts of petroleum fuels, therefore, continue to rely on barge and other means of transportation.

C. Forecasting Procedures and Assumptions and Probable Future Modal Split

As discussed earlier, whenever there is a new products pipeline in operation, barge shipments are expected to be reduced drastically. There were no new products pipelines in the study area during the 1969-76 period. As a result, reported waterborne shipments were relatively steady up to 1976 (Table 1).

In 1977, however, a new (16 inches diameter) products pipeline was completed. It connects refineries and other pipelines at Robinson, IL in BEA 56 (Terre Haute) to BEA 54 (Louisville). This new line has already caused a significant number of barge users to switch to pipeline transportation. By 1980, in terms of tonnage, it is expected that approximately one-half of the prospective users of the waterway will use the pipeline instead of barge for fuel transportation.

It should be noted that although the pipeline connects only Louisville and Robinson, the movements of petroleum fuels to BEA 54 from areas other than Robinson are expected to change as well. The available pipeline, which entails a lower transportation cost, has lowered the effective price (producer price plus transportation cost) of Illinois fuels. The effect will be a shift away from the

---

1. As a rough measure of the capital-output ratio, the U.S. pipeline industry requires 4 dollars of capital investment per dollar of revenue per year while the average industrial company requires only 0.50 dollars of investment for a dollar of revenue. Source: Howrey & Simon, Pipelines Owned by Oil Companies Provide a Pro-Competitive and Low-Cost Means of Energy Transportation to the Nation's Industries and Consumers (Washington, D.C.: n.p., 1978).

demand for petroleum fuels produced in the Gulf Coast in favor of fuels produced in Illinois. Discussions with gasoline distributors in Louisville confirm that such a shift has already begun to occur.

However, because of the high cost of pipeline construction and the prospect of declining production and consumption of petroleum fuels in the PSAs by the year 2000, the general consensus among government and industry sources is that no additional pipelines are expected to be built. Therefore, except for the shifts relating to BEA 54 discussed above, the future modal split is expected to conform to the 1976 patterns.

D. Probable Future Waterway Traffic Flows

The production of petroleum fuels in the PSAs for the 1976-90 period will increase faster than its consumption. This will cause net shipments by all modes to increase 0.72 percent per year. Net waterway shipments, however, will drop from 7.5 million tons in 1976 to 5.6 million tons in 2040. The total waterborne movements in the Ohio River System (inbound, outbound and local) will decrease from 20.9 million tons in 1976 to 15.8 million tons in 2040 (Table 9).

BEA-to-BEA waterborne traffic projections are presented in Table 10 (computer printout). Growth indices derived from the traffic projections are presented in Table 11.

Table 9. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Petroleum Fuels, Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

	Estimated	Projected					Average annual percentage change	
	1976	1980	1990	2000	2020	2040	1976-90	1976-2040
Production	15,841.7	18,162.3	24,509.0	22,916.0	17,530.7	10,202.9	3.17	(0.69)
Consumption	47,592.3	48,895.8	59,621.3	64,826.8	54,249.3	38,188.3	1.62	(0.34)
Net shipments (receipts)	(31,750.6)	(30,733.5)	(35,112.3)	(41,910.8)	(36,718.6)	(27,985.4)	0.72	(0.20)
Net waterborne	(7,521.7)	(4,349.0)	(3,332.6)	(6,064.6)	(6,115.8)	(5,619.4)	(5.65)	(0.45)
Net rail	(433.4)	(418.8)	(500.9)	(551.5)	(468.1)	(337.0)	1.04	(0.39)
Net pipeline and truck	(23,795.5)	(25,965.7)	(31,278.8)	(35,294.7)	(30,134.7)	(22,029.0)	1.97	(0.12)
Gross waterborne shipments:								
Outbound	1,293.1	1,589.6	1,543.0	2,176.3	1,534.3	1,695.5	(1.27)	0.42
Inbound	8,814.8	5,938.6	4,875.6	8,240.9	7,650.1	7,314.9	(4.14)	(0.29)
Local	10,835.5	13,638.0	20,761.3	17,883.2	13,442.6	6,796.7	4.75	(0.73)
Total	20,943.4	21,166.2	27,179.9	28,300.4	22,627.0	15,807.1	1.88	(0.44)

Note: Projected net shipments (receipts) determined by subtracting projected consumption from projected production. Projected modal split for the ORB was estimated from projections of modal split for each BEA and BEA segment. For most BEAs, projected modal split would remain constant in the future except when data, analyses, and conversations with industrial authorities indicated otherwise. Gross waterborne shipments (inbound, outbound, local) were projected by assuming that the relationship between gross and net shipments in 1976 would remain constant in the future except when data, analyses, and conversations with industrial authorities indicated otherwise.

Source: Tables 5, 7 and 8; Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

Table 10. Ohio River System: BEA-to-BEA Waterborne Traffic of Petroleum Fuels, Actual 1976 and Projected 1980-2040, Selected Years

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS 1976	1980	1990	2000	2020	2040
038	049	02	100	106	129	141	119	84
046	049	02	3338	2884	3014	5184	4463	3351
046	052	02	212	200	161	257	549	1457
046	054	02	1037	0	0	0	0	0
046	055	02	979	708	59	0	0	0
046	062	02	275	141	0	0	0	0
046	064	02	33	20	15	30	32	32
046	066	02	963	626	491	886	862	822
046	068	02	134	81	56	109	112	116
046	115	02	75	66	60	94	81	67
047	052	02	80	84	108	111	91	64
047	066	02	51	50	59	67	58	40
047	141	02	430	439	549	585	489	341
049	049	02	100	106	131	141	118	82
052	049	02	20	0	0	0	0	0
052	052	02	11810	23573	47216	34887	21258	8692
052	054	02	5880	7568	11290	9743	5951	2164
052	055	02	1770	3565	8845	3698	2092	550
052	062	02	10670	13434	13370	15205	13626	8995
052	064	02	3298	4271	6932	6540	4947	2444
052	066	02	12890	18355	29196	25071	18098	6058
052	068	02	3000	4089	5655	5157	3873	1908
052	114	02	140	244	227	352	203	242
052	137	02	89	135	221	181	126	56
052	138	02	230	377	375	525	335	329
053	052	02	30	31	38	40	33	23
054	049	02	50	92	170	66	49	10
054	052	02	740	807	1238	1225	897	143
054	054	02	770	801	918	1133	1029	753
054	055	02	10	14	27	19	13	12
054	062	02	360	309	249	300	358	229
054	064	02	30	27	31	42	39	31
054	066	02	400	400	458	520	451	334
054	068	02	610	555	544	703	661	542
054	114	02	356	390	278	563	405	886
055	046	02	5007	6239	5693	8136	5618	6519
055	047	02	1070	1552	2889	2012	1404	574
055	048	02	1480	2256	3872	2613	1991	728
055	049	02	901	1688	4103	1444	1260	210
055	052	02	3890	6983	14751	9130	5773	0
055	054	02	5241	3234	4796	3716	2872	818
055	055	02	1580	1967	5756	3079	1913	0
055	057	02	210	244	376	317	227	110

(Continued)

Table 10. (Continued)

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS 1976	1980	1990	2000	2020	2040
055	062	02	4075	3223	3579	4525	4124	0
055	064	02	700	676	1037	979	777	142
055	066	02	1307	1312	1988	1666	1246	427
055	068	02	511	518	691	621	508	274
055	077	02	1270	1585	1459	2182	1519	1759
055	078	02	1170	1455	1333	2007	1399	1642
055	079	02	500	581	894	755	540	262
055	114	02	2247	2780	2620	3786	2611	2719
055	115	02	2055	2339	4073	2988	2096	812
055	134	02	22	26	40	33	24	12
055	138	02	673	786	734	1066	735	774
055	140	02	20	23	36	30	22	11
055	915	02	33	38	60	50	36	17
062	052	02	3822	7162	6968	9203	8210	4361
062	054	02	8639	5071	3983	6635	6600	6376
062	055	02	540	715	979	886	681	399
062	062	02	1956	1530	833	1178	1305	4663
062	064	02	1120	921	816	1331	1362	1858
062	066	02	1239	1157	978	1461	1386	1336
062	115	02	1060	1320	1302	1639	1477	1236
062	138	02	113	108	58	154	141	306
062	915	02	56	55	48	68	64	62
064	066	02	10	9	13	14	11	8
066	052	02	1340	1503	2057	1853	1386	913
066	054	02	78	50	58	174	156	109
066	064	02	300	260	321	411	373	253
066	065	02	1600	1453	1741	1909	1598	1118
066	066	02	3441	3372	4122	4800	4140	2884
066	068	02	81	75	80	103	93	73
066	077	02	33	37	25	51	38	68
066	138	02	22	20	15	33	29	46
068	052	02	90	169	319	157	33	24
068	062	02	22	32	36	28	11	6
068	064	02	175	155	181	225	205	127
068	065	02	1350	1243	1412	1505	1257	873
068	066	02	2423	2464	2857	3244	2796	1953
068	068	02	210	195	199	240	214	166
077	048	02	846	677	617	923	843	680
077	049	02	156	65	51	103	81	122
077	052	02	99	24	4	9	15	11
077	054	02	170	115	53	135	132	125
077	055	02	20	7	1	1	0	0
077	064	02	111	64	53	151	158	229
077	115	02	30	10	6	13	12	22
078	066	02	350	343	427	474	396	277
079	055	02	20	23	34	30	22	11
114	047	02	1320	1148	1089	1599	1441	1172
114	048	02	1057	1033	937	1402	1285	1080
114	049	02	2107	1943	2014	2040	1700	2248

(Continued)

Table 10. (Continued)

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	1976	1980	1990	2000	2020	2040
			HUNDREDS OF TONS					
114	052	02	56	249	100	156	187	212
114	054	02	7179	1400	998	2907	4035	3762
114	055	02	5631	5479	4848	8655	6797	4370
114	062	02	2016	871	0	0	0	0
114	066	02	1919	2094	1606	2994	2913	4792
114	068	02	145	93	60	113	123	120
114	115	02	460	379	339	525	472	415
115	046	02	80	91	100	579	463	613
115	047	02	120	166	134	122	100	60
115	066	02	30	0	0	0	0	0
115	115	02	3310	3479	4214	4071	3426	2112
115	140	02	230	243	289	310	259	181
119	062	02	111	108	96	135	127	123
119	068	02	134	134	157	170	142	99
134	049	02	492	467	475	723	600	578
134	054	02	740	471	348	639	629	601
134	055	02	40	38	0	0	0	0
134	062	02	30	17	0	0	0	0
134	064	02	11	6	5	9	10	10
134	066	02	820	432	340	615	607	581
137	054	02	2010	213	139	291	299	287
137	055	02	280	541	587	871	712	474
137	062	02	122	260	10	243	354	687
137	115	02	553	974	887	1354	1199	1011
138	047	02	1603	1404	1335	1935	1755	1431
138	048	02	245	216	195	295	272	328
138	049	02	5922	6650	7326	8729	7136	4145
138	052	02	5756	4231	2147	3379	3143	1577
138	054	02	7237	1165	839	1570	1541	2055
138	055	02	1470	1345	1044	1405	1108	635
138	062	02	1518	820	237	4326	4419	8436
138	064	02	1351	767	638	1265	1279	1288
138	066	02	10991	7210	5550	10189	10178	9870
138	068	02	1071	638	437	864	862	944
138	115	02	2811	2375	2148	3283	2909	2462
139	064	02	22	22	31	34	28	20
140	047	02	220	182	149	258	239	202
140	048	02	1102	923	775	1272	1177	1027
140	050	02	378	399	476	512	435	298
140	052	02	1114	628	475	902	743	477
140	054	02	72	24	16	51	51	48
140	062	02	271	118	50	139	222	679
140	066	02	865	433	286	634	626	601
140	068	02	120	69	41	85	87	96
140	115	02	30	20	15	30	28	31
141	047	02	133	117	111	161	147	112

(Continued)

Table 10. (Continued)

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS 1976	1980	1990	2000	2020	2040
141	048	02	378	346	315	463	425	340
141	049	02	70	83	98	208	174	124
141	052	02	1500	1079	879	1335	1172	1241
141	054	02	770	606	463	887	861	821
141	055	02	180	172	217	251	182	111
141	064	02	33	21	16	31	33	33
141	066	02	3033	1741	1392	2517	2378	2281
141	068	02	1150	697	477	897	900	950
143	052	02	440	314	259	412	379	364
143	054	02	60	24	18	57	56	53
143	066	02	40	26	20	36	34	32
144	049	02	11	11	15	16	13	9
		TOTAL	209434	211662	271799	283004	226270	158071

Note: BEA 915 refers to counties of BEA 115 which are destinations of waterborne movements shipped to points on the Mississippi River.

Source: Robert R. Nathan Associates, Inc.

Table 11. Ohio River System: Growth Rates of Petroleum Fuels Waterborne Commerce, BEA to BEA, Projected 1976-2040, Selected Years

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
038049	02	100	1000	1060	1290	1410	1190	840
046049	02	3338	1000	864	903	1553	1337	1004
046052	02	212	1000	943	759	1212	2590	6873
046054	02	1037	1000	0	0	0	0	0
046055	02	979	1000	723	60	0	0	0
046062	02	275	1000	513	0	0	0	0
046064	02	33	1000	606	455	909	970	970
046066	02	963	1000	650	510	920	895	854
046068	02	134	1000	604	418	813	836	866
046115	02	75	1000	880	800	1253	1080	893
047052	02	80	1000	1050	1350	1388	1138	800
047066	02	51	1000	980	1157	1314	1137	784
047141	02	430	1000	1021	1277	1360	1137	793
049049	02	100	1000	1060	1310	1410	1180	820
052049	02	20	1000	0	0	0	0	0
052052	02	11810	1000	1996	3998	2954	1800	736
052054	02	5880	1000	1287	1920	1657	1012	368
052055	02	1770	1000	2014	4997	2089	1182	311
052062	02	10670	1000	1259	1253	1425	1277	843
052064	02	3298	1000	1295	2102	1983	1500	741
052066	02	12890	1000	1424	2265	1945	1404	470
052068	02	3000	1000	1363	1885	1719	1291	636
052114	02	140	1000	1743	1621	2514	1450	1729
052137	02	89	1000	1517	2483	2034	1416	629
052138	02	230	1000	1639	1630	2283	1457	1430
053052	02	30	1000	1033	1267	1333	1100	767
054049	02	50	1000	1840	3400	1320	980	200
054052	02	740	1000	1091	1673	1655	1212	193
054054	02	770	1000	1040	1192	1471	1336	978
054055	02	10	1000	1400	2700	1900	1300	1200
054062	02	360	1000	858	692	833	994	636
054064	02	30	1000	900	1033	1400	1300	1033
054066	02	400	1000	1000	1145	1300	1128	835
054068	02	610	1000	910	892	1152	1084	889
054114	02	356	1000	1096	781	1581	1306	2489
055046	02	5007	1000	1246	1137	1625	1122	1302
055047	02	1070	1000	1450	2700	1880	1312	536
055048	02	1480	1000	1524	2616	1901	1345	492
055049	02	901	1000	1873	4554	1603	1398	233
055052	02	3890	1000	1795	3792	2347	1484	0
055054	02	5241	1000	617	915	709	548	156
055055	02	1580	1000	1245	3643	1949	1211	0
055057	02	210	1000	1162	1790	1510	1081	524
055062	02	4095	1000	787	874	1105	1007	0
055064	02	700	1000	966	1481	1399	1110	203

(Continued)

Table 11. (Continued)

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
055066	02	1307	1000	1004	1521	1275	953	327
055068	02	511	1000	1014	1352	1215	994	536
055077	02	1270	1000	1248	1149	1718	1196	1385
055078	02	1170	1000	1244	1139	1715	1196	1403
055079	02	500	1000	1162	1788	1510	1080	524
055114	02	2247	1000	1237	1166	1685	1162	1210
055115	02	2055	1000	1138	1982	1454	1020	395
055134	02	22	1000	1182	1818	1500	1091	545
055138	02	673	1000	1168	1091	1584	1092	1150
055140	02	20	1000	1150	1800	1500	1100	550
055915[d]	02	33	1000	1152	1818	1515	1091	515
062052	02	3822	1000	1874	1823	2408	2148	1141
062054	02	8639	1000	587	461	768	764	738
062055	02	540	1000	1324	1813	1641	1261	739
062062	02	1956	1000	782	426	602	667	2384
062064	02	1120	1000	822	729	1188	1216	1659
062066	02	1239	1000	934	789	1179	1119	1078
062115	02	1060	1000	1245	1228	1546	1393	1166
062138	02	113	1000	956	513	1363	1248	2708
062915[d]	02	56	1000	982	857	1214	1143	1107
064066	02	10	1000	900	1300	1400	1100	800
066052	02	1340	1000	1122	1535	1384	1034	681
066054	02	78	1000	641	744	2231	2000	1397
066064	02	300	1000	867	1070	1370	1243	843
066065	02	1600	1000	908	1088	1193	999	699
066066	02	3441	1000	980	1198	1395	1203	838
066068	02	81	1000	926	988	1272	1148	901
066077	02	33	1000	1121	758	1545	1152	2061
066138	02	22	1000	909	682	1500	1318	2091
068052	02	90	1000	1878	3544	1744	367	267
068062	02	22	1000	1455	1636	1273	500	273
068064	02	175	1000	886	1034	1286	1171	726
068065	02	1350	1000	921	1046	1115	931	647
068066	02	2423	1000	1017	1179	1339	1154	806
068068	02	210	1000	929	948	1143	1019	790
077048	02	846	1000	800	729	1091	996	804
077049	02	156	1000	417	327	660	519	782
077052	02	99	1000	242	40	91	152	111
077054	02	170	1000	676	312	794	776	735
077055	02	20	1000	350	50	50	0	0
077064	02	111	1000	577	477	1360	1423	2063
077115	02	30	1000	333	200	433	400	733
078066	02	350	1000	980	1220	1354	1131	791
079055	02	20	1000	1150	1700	1500	1100	550
114047	02	1320	1000	870	825	1211	1092	888
114048	02	1057	1000	977	886	1326	1216	1022
114049	02	2107	1000	922	956	968	807	1067
114052	02	56	1000	4446	1786	2786	3339	3786

(Continued)

Table 11. (Continued)

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
114054	02	7179	1000	195	139	405	562	524
114055	02	5631	1000	973	861	1537	1207	776
114062	02	2016	1000	432	0	0	0	0
114066	02	1919	1000	1091	837	1560	1518	2497
114068	02	145	1000	641	414	779	848	828
114115	02	460	1000	824	737	1141	1026	902
115046	02	80	1000	1138	1250	7238	5788	7663
115047	02	120	1000	1383	1117	1017	833	500
115066	02	30	1000	0	0	0	0	0
115115	02	3310	1000	1051	1273	1230	1035	638
115140	02	230	1000	1057	1257	1348	1126	787
119062	02	111	1000	973	865	1216	1144	1108
119068	02	134	1000	1000	1172	1269	1060	739
134049	02	492	1000	949	965	1470	1220	1175
134054	02	740	1000	636	470	864	850	812
134055	02	40	1000	950	0	0	0	0
134062	02	30	1000	567	0	0	0	0
134064	02	11	1000	545	455	818	909	909
134066	02	820	1000	527	415	750	740	709
137054	02	2010	1000	106	69	145	149	143
137055	02	280	1000	1932	2096	3111	2543	1693
137062	02	122	1000	2131	82	1992	2902	5631
137115	02	553	1000	1761	1604	2448	2168	1828
138047	02	1603	1000	876	833	1207	1095	893
138048	02	245	1000	882	796	1204	1110	1339
138049	02	5922	1000	1123	1237	1474	1205	700
138052	02	5756	1000	735	373	587	546	274
138054	02	7237	1000	161	116	217	213	284
138055	02	1470	1000	915	710	956	754	432
138062	02	1518	1000	540	156	2850	2911	5557
138064	02	1351	1000	568	472	936	947	953
138066	02	10991	1000	656	505	927	926	898
138068	02	1071	1000	596	408	807	805	881
138115	02	2811	1000	845	764	1168	1035	876
139064	02	22	1000	1000	1409	1545	1273	909
140047	02	220	1000	827	677	1173	1086	918
140048	02	1102	1000	838	703	1154	1068	932
140050	02	378	1000	1056	1259	1354	1151	788
140052	02	1114	1000	564	426	810	667	428
140054	02	72	1000	333	222	708	708	667
140062	02	271	1000	435	185	513	819	2506
140066	02	865	1000	501	331	733	724	695
140068	02	120	1000	575	342	708	725	800
140115	02	30	1000	667	500	1000	933	1033
141047	02	133	1000	880	835	1211	1105	842
141048	02	378	1000	915	833	1225	1124	899
141049	02	70	1000	1186	1400	2971	2486	1771
141052	02	1500	1000	719	586	890	781	827

(Continued)

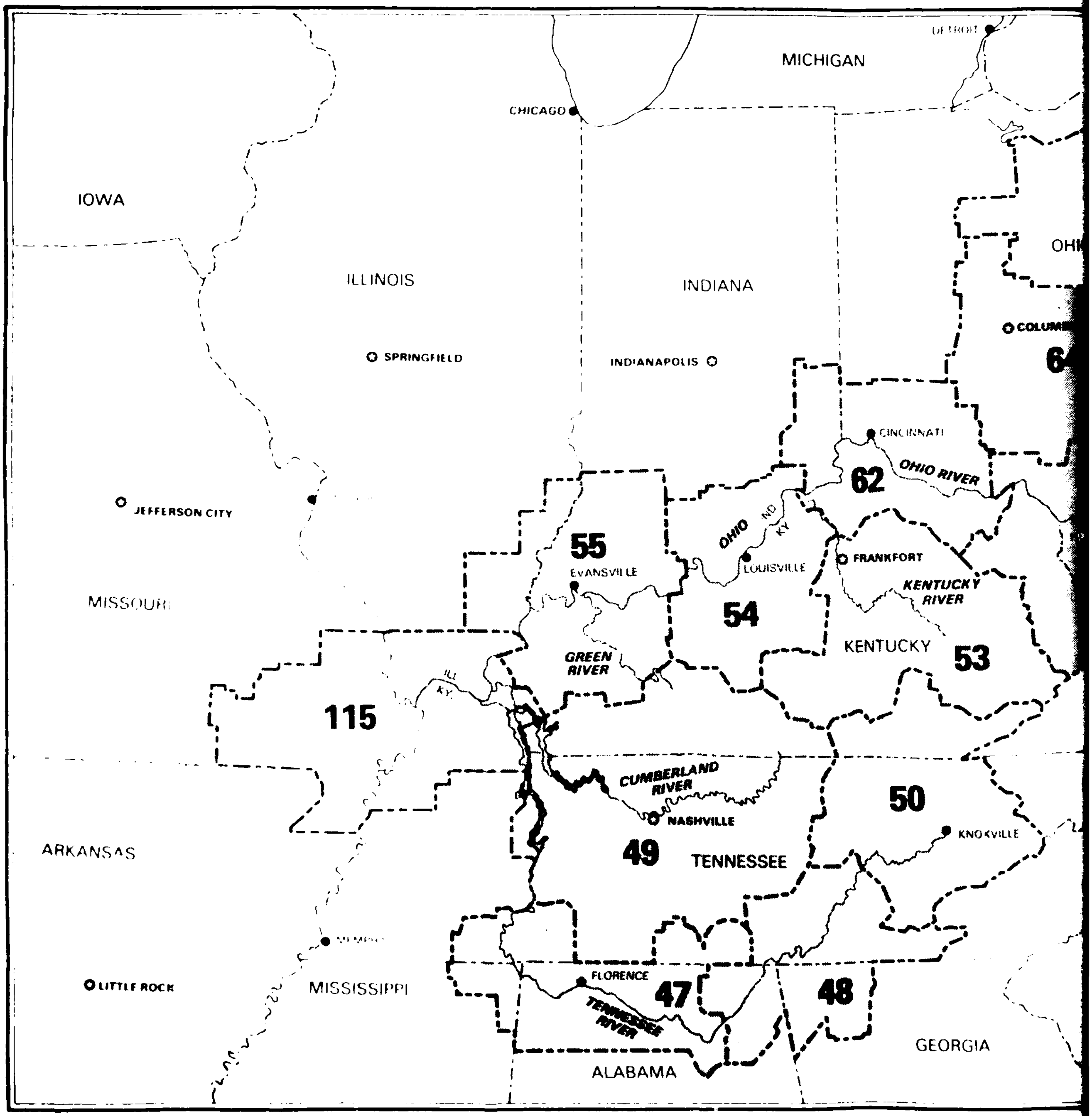
Table 11. (Continued)

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
141054	02	770	1000	787	601	1152	1118	1066
141055	02	180	1000	956	1206	1394	1011	617
141064	02	33	1000	636	485	939	1000	1000
141066	02	3033	1000	574	459	830	784	752
141068	02	1150	1000	606	415	780	783	826
143052	02	440	1000	714	599	936	861	827
143054	02	60	1000	400	300	950	933	883
143066	02	40	1000	650	500	900	850	800
144049	02	11	1000	1000	1364	1455	1182	818

a. The first three digits indicate the BEA of origin; the last three digits indicate the BEA of destination.
b. Hundreds of tons.
c. Growth rates are reported such that 1000 equals the index value reported in the third column.
d. BEA 915 refers to counties of BEA 115 which are destinations of waterborne movements which are shipped to points on the Mississippi River.
Source: Robert R. Nathan Associates, Inc.

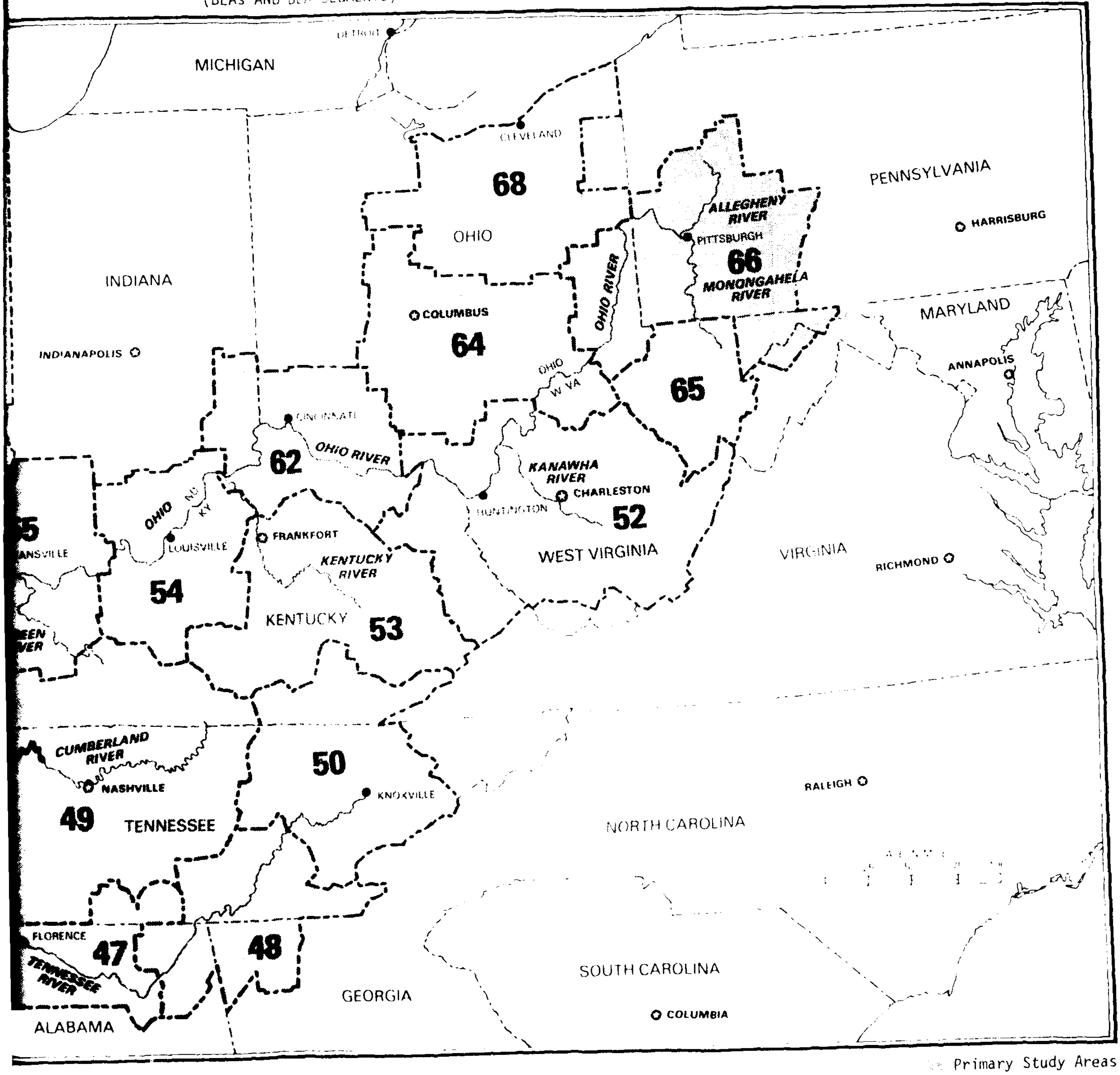
V. APPENDIX A

MAP A-1. OHIO RIVER BASIN: PRIMARY STUDY AREAS FOR PE
(BEAs AND BEA SEGMENTS)



SOURCE: Robert R. Nathan Associates, Inc.

MAP A-1. OHIO RIVER BASIN: PRIMARY STUDY AREAS FOR PETROLEUM FUELS
(BEAs AND BEA SEGMENTS)



Primary Study Areas

Table A-1. Ohio River Basin: Primary Study Areas
for Petroleum Fuels
(BEAs and BEA segment)

BEA 47: Huntsville, AL
- Hardin, TN
- McNairy, TN
- Wayne, TN
- Alcorn, MS
- Tishomingo, MS
- Colbert, AL
- Franklin, AL
- Lauderdale, AL
- Lawrence, AL
- Limestone, AL
- Madison, AL
- Marshall, AL
- Morgan, AL
- Franklin, TN
- Lincoln, TN

BEA 48: Chattanooga, TN
- Jackson, AL
- DeKalb, AL
- Catoosa, GA
- Chattooga, GA
- Dade, GA
- Gordon, GA
- Murray, GA
- Walker, GA
- Whitfield, GA
- Bledsoe, TN
- Bradley, TN
- Grundy, TN
- Hamilton, TN
- Marion, TN
- McMinn, TN
- Meigs, TN
- Polk, TN
- Rhea, TN
- Sequatchie, TN

BEA 49: Nashville, TN
- Allen, KY
- Barren, KY
- Butler, KY
- Christian, KY
- Clinton, KY
- Cumberland, KY
- Edmonson, KY
- Logan, KY
- Metcalfe, KY
- Monroe, KY
- Simpson, KY
- Todd, KY
- Trigg, KY
- Warren, KY
- Bedford, TN
- Benton, TN
- Cannon, TN
- Cheatham, TN
- Clay, TN
- Coffee, TN
- Davidson, TN
- Dekalb, TN
- Dickson, TN
- Giles, TN
- Hickman, TN
- Houston, TN
- Humphreys, TN
- Jackson, TN
- Lawrence, TN
- Lewis, TN
- Macon, TN
- Maury, TN
- Marshall, TN
- Montgomery, TN
- Overton, TN
- Perry, TN
- Pickett, TN
- Putnam, TN
- Robertson, TN
- Rutherford, TN
- Smith, TN
- Stewart, TN
- Sumner, TN
- Trousdale, TN
- Van Buren, TN
- Warren, TN
- White, TN
- Williamson, TN
- Wilson, TN

BEA 50: Knoxville, TN
- Bell, KY
- Harlan, KY
- Knox, KY
- Laurel, KY
- McCreary, KY
- Wayne, KY
- Whitley, KY
- Anderson, TN
- Blount, TN
- Campbell, TN
- Clairborne, TN
- Cocke, TN
- Cumberland, TN
- Fentress, TN
- Grainger, TN
- Hamblen, TN
- Jefferson, TN
- Knox, TN
- Loudon, TN
- Monroe, TN
- Morgan, TN
- Roane, TN
- Scott, TN
- Sevier, TN
- Union, TN

BEA 52: Huntington, WV
- Boyd, KY
- Carter, KY
- Elliot, KY
- Floyd, KY
- Greenup, KY
- Johnson, KY
- Lawrence, KY
- Martin, KY
- Pike, KY
- Rowan, KY
- Gallia, OH
- Lawrence, OH
- Meigs, OH
- Scioto, OH
- Boone, WV
- Braxton, WV
- Cabell, WV
- Calhoun, WV
- Clay, WV
- Fayette, WV
- Gilmer, WV
- Greenbrier, WV
- Jackson, WV
- Kanawha, WV
- Lincoln, WV
- Logan, WV
- Mason, WV
- Mingo, WV
- Monroe, WV
- Nicholas, WV
- Pocahontas, KY
- Putnam, WV
- Raleigh, WV
- Roane, WV
- Sumners, WV
- Wayne, WV
- Webster, WV
- Wyoming, WV

BEA 53: Lexington, KY
- Adair, KY
- Anderson, KY
- Bath, KY
- Bourbon, KY
- Boyle, KY
- Breathitt, KY
- Casey, KY
- Clark, KY
- Clay, KY
- Estill, KY
- Fayette, KY
- Franklin, KY
- Garrard, KY
- Green, KY
- Harrison, KY
- Jackson, KY
- Jessamine, KY
- Knott, KY
- Lee, KY
- Leslie, KY
- Letcher, KY
- Lincoln, KY
- Madison, KY
- Magoffin, KY
- Menifee, KY
- Mercer, KY
- Montgomery, KY
- Morgan, KY
- Nicholas, KY
- Owsley, KY
- Perry, KY
- Powell, KY
- Pulaski, KY
- Rockcastle, KY
- Russell, KY
- Scott, KY

(Continued)

Table A-1. (Continued)

Taylor, KY
Wolfe, KY
Woodford, KY

BEA 54: Louisville, KY
Clark, IN
Crawford, IN
Floyd, IN
Harrison, IN
Jefferson, IN
Orange, IN
Scott, IN
Washington, IN
Breckenridge, KY
Bullitt, KY
Grayson, KY
Hardin, KY
Hart, KY
Henry, KY
Jefferson, KY
Larue, KY
Marion, KY
Meade, KY
Nelson, KY
Oldham, KY
Shelby, KY
Spencer, KY
Trimble, KY
Washington, KY

BEA 55: Evansville, IN
Caldwell, KY
Crittenden, KY
Daviess, KY
Hancock, KY
Henderson, KY
Hopkins, KY
McLean, KY
Muhlenberg, KY
Ohio, KY
Union, KY
Webster, KY
Edwards, IL
Gallatin, IL
Hamilton, IL
Lawrence, IL
Saline, IL
Wabash, IL
White, IL
Daviess, IN
Dubois, IN
Gibson, IN
Knox, IN
Martin, IN
Perry, IN
Pike, IN
Posey, IN
Spencer, IN
Vanderburgh, IN
Warrick, IN

BEA 62: Cincinnati, OH
Dearborn, IN
Fayette, IN
Franklin, IN
Ohio, IN
Ripley, IN
Switzerland, IN
Union, IN
Boone, KY
Bracken, KY
Campbell, KY
Carroll, KY
Fleming, KY
Gallatin, KY
Grant, KY
Kenton, KY
Lewis, KY
Mason, KY
Owen, KY
Pendleton, KY
Robertson, KY
Adams, OH
Butler, OH
Brown, OH
Clermont, OH
Clinton, OH
Hamilton, OH
Highland, OH
Warren, OH

BEA 64: Columbus, OH
Athens, OH
Delaware, OH
Fairfield, OH
Fayette, OH
Franklin, OH
Guernsey, OH
Hocking, OH
Jackson, OH
Licking, OH
Madison, OH
Marion, OH
Morgan, OH
Muskingham, OH
Noble, OH
Perry, OH
Pike, OH
Pickaway, OH
Ross, OH
Vinton, OH
Union, OH
Washington, OH
Pleasants, WV
Ritchie, WV
Wirt, WV
Wood, WV

BEA 65: Clarksburg, WV
Barbour, WV
Doodridge, WV
Harrison, WV
Lewis, WV
Marion, WV
Monongalia, WV
Preston, WV
Randolph, WV
Taylor, WV
Tucker, WV
Upshur, WV

BEA 66: Pittsburgh, PA
Allegany, MD
Garrett, MD
Belmont, OH
Harrison, OH
Jefferson, OH
Monroe, OH
Allegheny, PA
Armstrong, PA
Beaver, PA
Butler, PA
Cambia, PA
Clarion, PA
Fayette, PA
Greene, PA
Indiana, PA
Somerset, PA
Washington, PA
Westmoreland, PA
Brooke, WV
Hancock, WV
Marshall, WV
Mineral, WV
Ohio, WV
Tyler, WV
Wetzel, WV

BEA 68: Cleveland, OH (segment)
Carroll, OH
Columbiana, OH

BEA 115: Paducah, KY (segment)
Hardin, IL
Johnson, IL
Massac, IL
Pope, IL
Pulaski, IL
Union, IL
Ballard, KY
Calloway, KY
Graves, KY
Livingston, KY
Lyon, KY
Marshall, KY
McCracken, KY

Source: Robert R. Nathan Associates, Inc.

VI. APPENDIX B: REFINERIES AND PIPELINES IN THE OHIO RIVER BASIN[1]

Pipelines are the dominant mode of transportation used in the ORB for carrying crude oil from production sites to refineries and for carrying refined petroleum products from the refineries to consumers. An extensive network of both crude oil and products pipelines crisscrosses the region.

A. Refineries

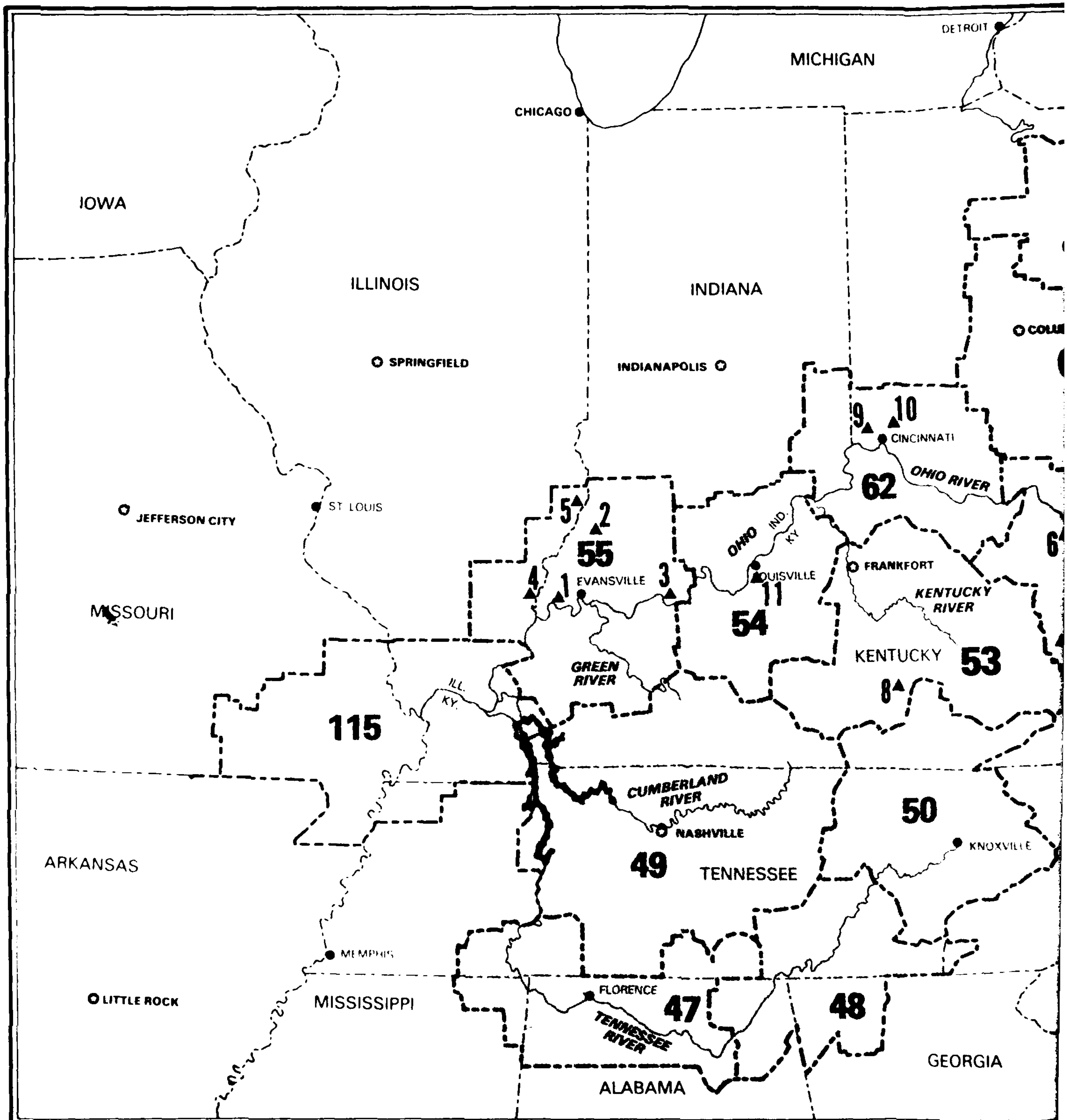
The 14 refineries in the ORB are located in BEAs 52 (Huntington), 53 (Lexington), 54 (Louisville), 55 (Evansville), 62 (Cincinnati), 64 (Columbus) and 66 (Pittsburgh). The location of these refineries is presented in Map B-1. The 1976 crude run capacity of these refineries was about 28 million tons. During the same year 22 million tons of crude oil were refined, yielding 15.9 million tons of petroleum fuels. This represented about 80 percent utilization of available capacity.

BEA 55 (Evansville), the largest producing PSA of petroleum fuels, has five refineries. Three are located in Indiana: the Indiana Farm Bureau Cooperative Association in Mount Vernon, the Kentucky Oil and Refining Company in Troy, and Princeton Refining, Inc. in Princeton. Their combined capacity is 3.9 thousand tons per day. The Richards M. T., Inc. refinery in Crossville, Illinois has a daily capacity of one hundred tons. The largest refinery in

---

1. Unless specifically noted, all information was obtained from American Petroleum Institute, Statistics Divisions, Washington, D.C. Because of disclosure problems, information is not available at refinery levels. The data provided in this Appendix represent only a rough estimate of the refinery and pipeline capacities.

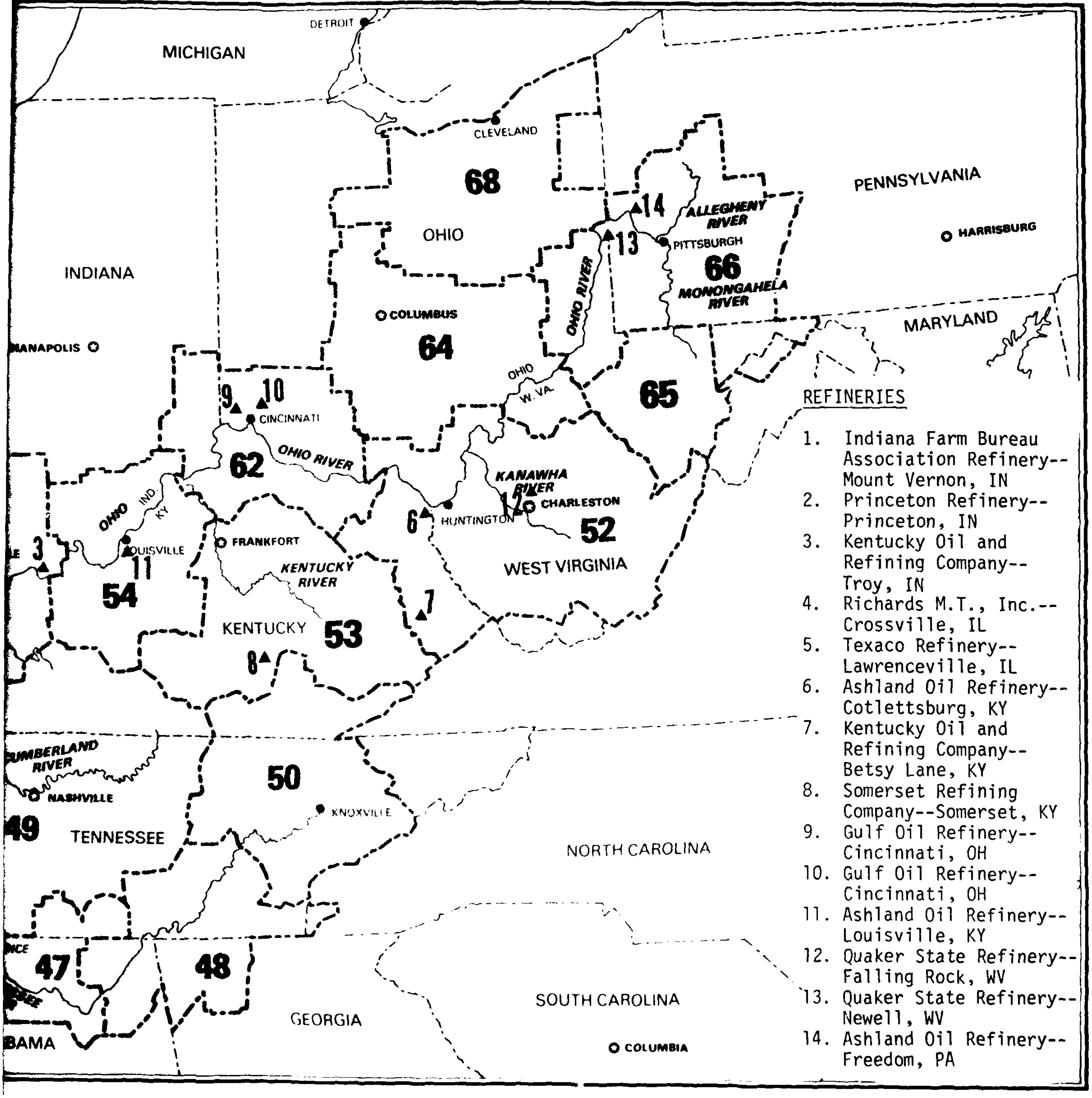
MAP B-1. PETROLEUM PRODUCTS REFINERIES IN THE PRIM



Source: Petroleum Products Pipeline Map of the United States, 1979 ed., American Petroleum Institute.

Primary Study Areas

ETROLEUM PRODUCTS REFINERIES IN THE PRIMARY STUDY AREA



tes, Primary Study Areas

this BEA is the Texaco refinery in Lawrenceville, Illinois which has daily capacity of 12 thousand tons.

BEA 52 (Huntington) produced 5.5 million tons of petroleum fuels in 1976. One large refinery owned by Ashland Oil in Catlettsburg, Kentucky accounted for nearly all of this production. Its daily capacity is 20 thousand tons. A smaller refinery, the Kentucky Oil and Refining Company in Betsy Lane, Kentucky produces 86 tons of fuels per day. BEA 62 (Cincinnati) has two Gulf Oil refineries in the Cincinnati area. Together they are capable of producing about 12.5 thousand tons of petroleum fuels per day.

BEAs 53 (Lexington), 54 (Louisville) and 64 (Columbus) each have one refinery. Somerset Refining Company in Somerset, Kentucky is located in BEA 53 (Lexington) and has a daily fuels production capacity of seven hundred tons. In BEA 54 (Louisville), the Ashland Oil Refinery in Louisville is capable of producing 36 hundred tons a day. Falling Rock, West Virginia in BEA 64 (Columbus) is the site of the Quaker State refinery which has a daily capacity of seven hundred tons.

Both the Ashland Oil refinery in Freedom, Pennsylvania and the Quaker State refinery in Newell, West Virginia are located in BEA 66 (Pittsburgh). They have a combined daily capacity of 16 hundred tons a day.

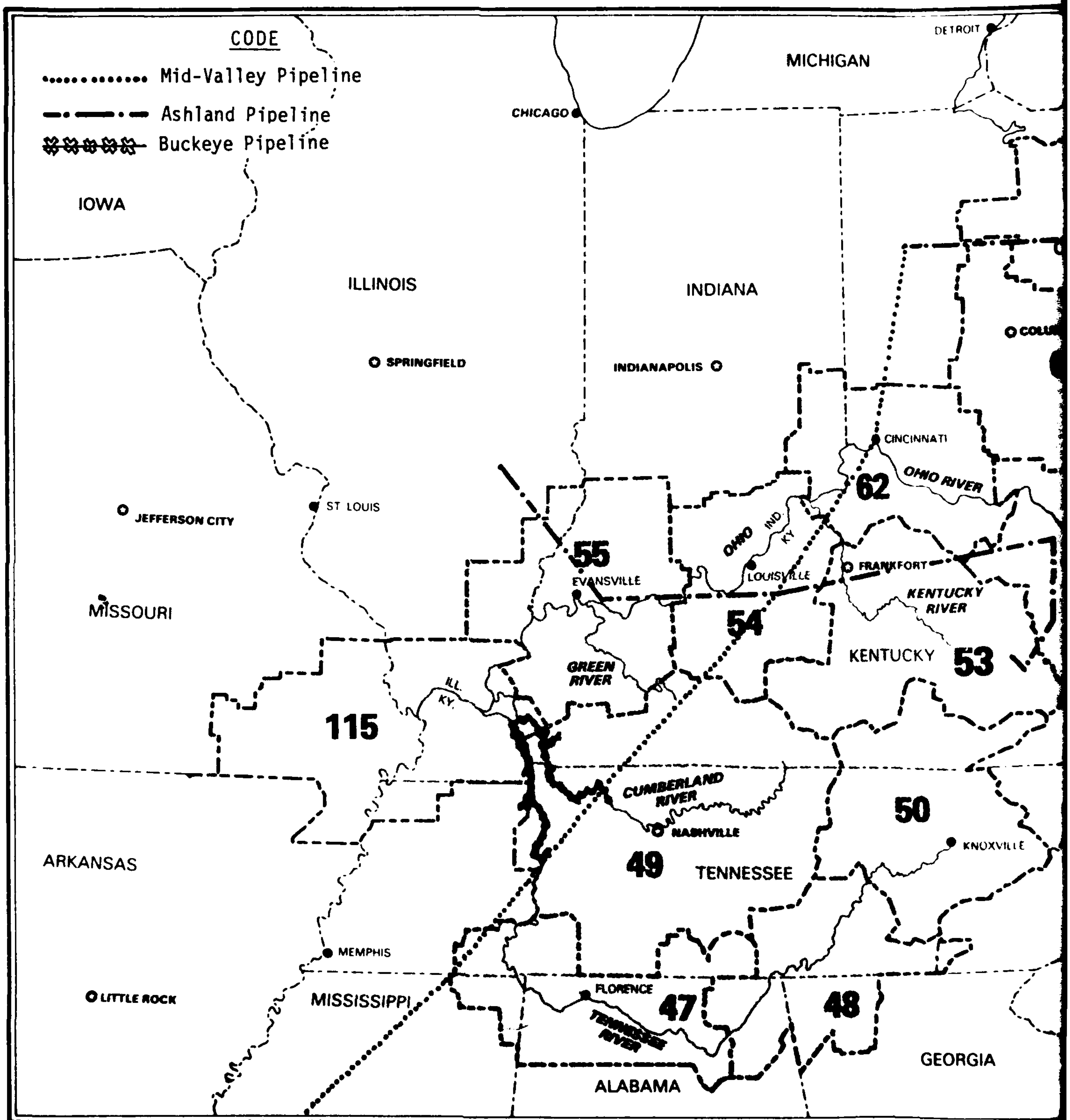
B. Crude Oil Pipelines

Four major pipelines deliver crude oil to the refineries within the ORB[1] (see Map B-2). The Mid-Valley Pipeline carries both imported and domestic crude oil from Texas to Lima, Ohio. It measures between 20 and 22 inches in diameter and has the capacity to carry nearly 40 thousand tons of oil a day. Refineries in BEAs 62 (Cincinnati) and 64 (Columbus) are linked to this pipeline with six to eight-inch diameter delivery lines.

The Ashland Pipeline Company, a subsidiary of Ashland Oil Company, has a series of pipelines which run in the ORB. The largest segment is the 267 miles of 24-inch diameter pipeline running between eastern Illinois and Catlettsburg, Kentucky. It serves refir ries in BEAs 52 (Huntington), 53 (Lexington), 55

1. Worldwide Pipelines and Contractors Directory, 1977 ed. (Tulsa: Petroleum Publishing Company, 1979).

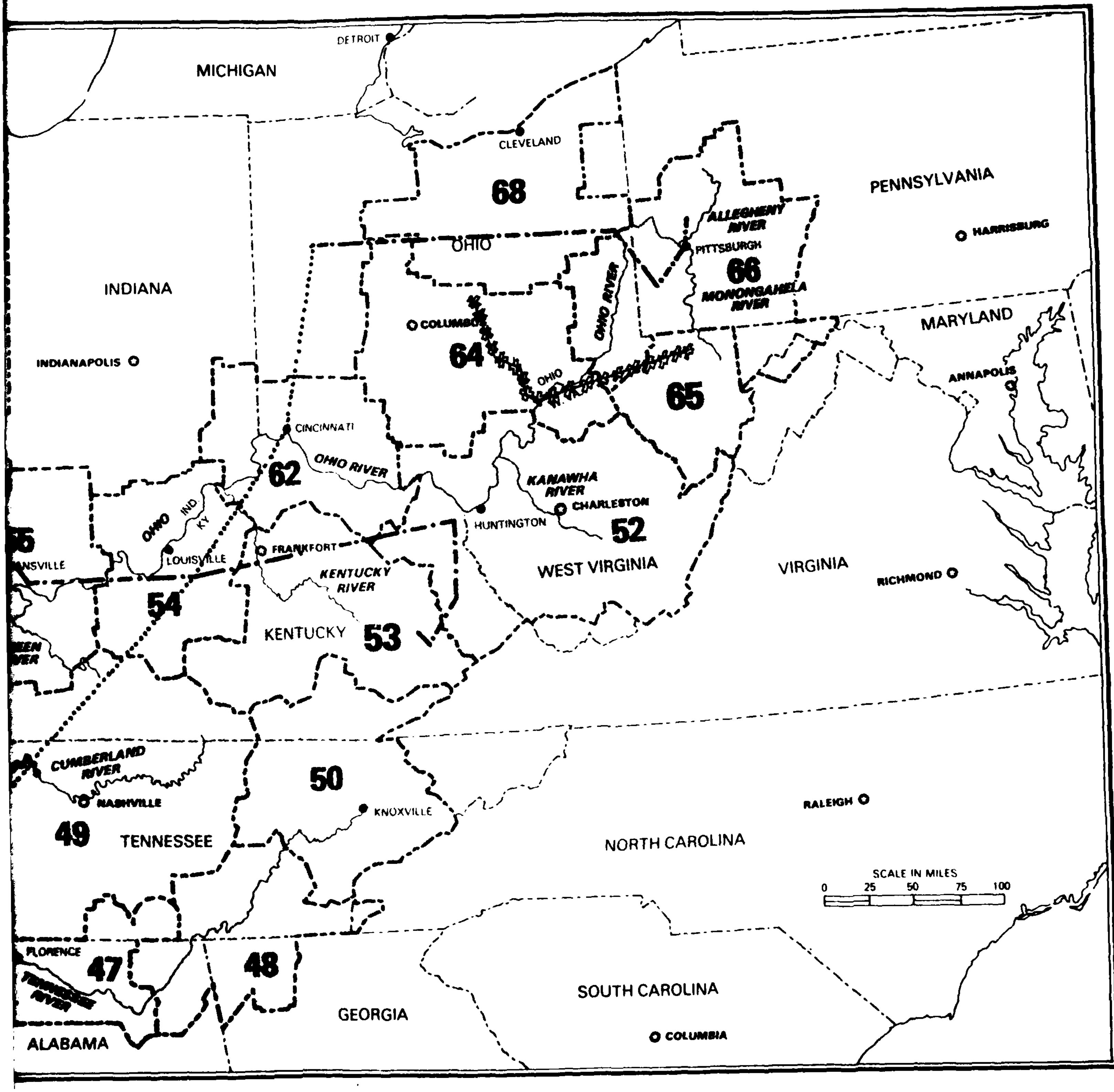
MAP B-2. CRUDE OIL PIPELINES IN THE OH



Source: Crude Oil Pipelines in the United States, 1979 ed., American Petroleum Institute.

Primary Study Areas

P B-2. CRUDE OIL PIPELINES IN THE OHIO RIVER BASIN



79 ed., American   Primary Study Areas

(Evansville) and 64 (Columbus). Smaller lines run south to the Betsy Lane and Somerset refineries. A 12-inch pipeline running from Lima, Ohio to western Pennsylvania carries crude oil through BEAs 65 (Clarksburg), 66 (Pittsburgh) and 68 (Cleveland). The entire Ashland system has the capacity to carry 61 thousand tons of crude oil a day.

The Buckeye lines serves the region with 462 miles of eight to 30-inch diameter delivery lines. The six-inch line between Killbuck, Ohio to Monogolia, West Virginia serves the refinery in BEA 64 (Columbus). The entire Buckeye system has the capacity to deliver 50 thousand tons of crude oil a day.

C. Petroleum Products (Fuels) Pipelines

The amount of petroleum fuels consumed in the PSAs exceeds the amount produced in the region.[1] A series of pipelines brings petroleum fuels into the region from refineries in the Gulf and the East Coasts (see Map B-3). Most of the more than seven million tons of petroleum fuels used in BEAs 48 (Chattanooga), 49 (Nashville) and 50 (Knoxville) are transported through the Colonial Pipeline system. This system consists of 4,135 miles of pipeline running from Houston up the East Coast and has the capacity to handle 255.3 thousand tons of petroleum products a day. Two trunk lines, eight and 12 inches in diameter, connect BEAs 48 (Chattanooga) and 49 (Nashville) with the main 36-inch line which runs through Atlanta. Knoxville is connected with the main Atlanta line by two 10-inch trunk lines running from Chattanooga. One of these lines is owned by the Plantation Pipeline Company.

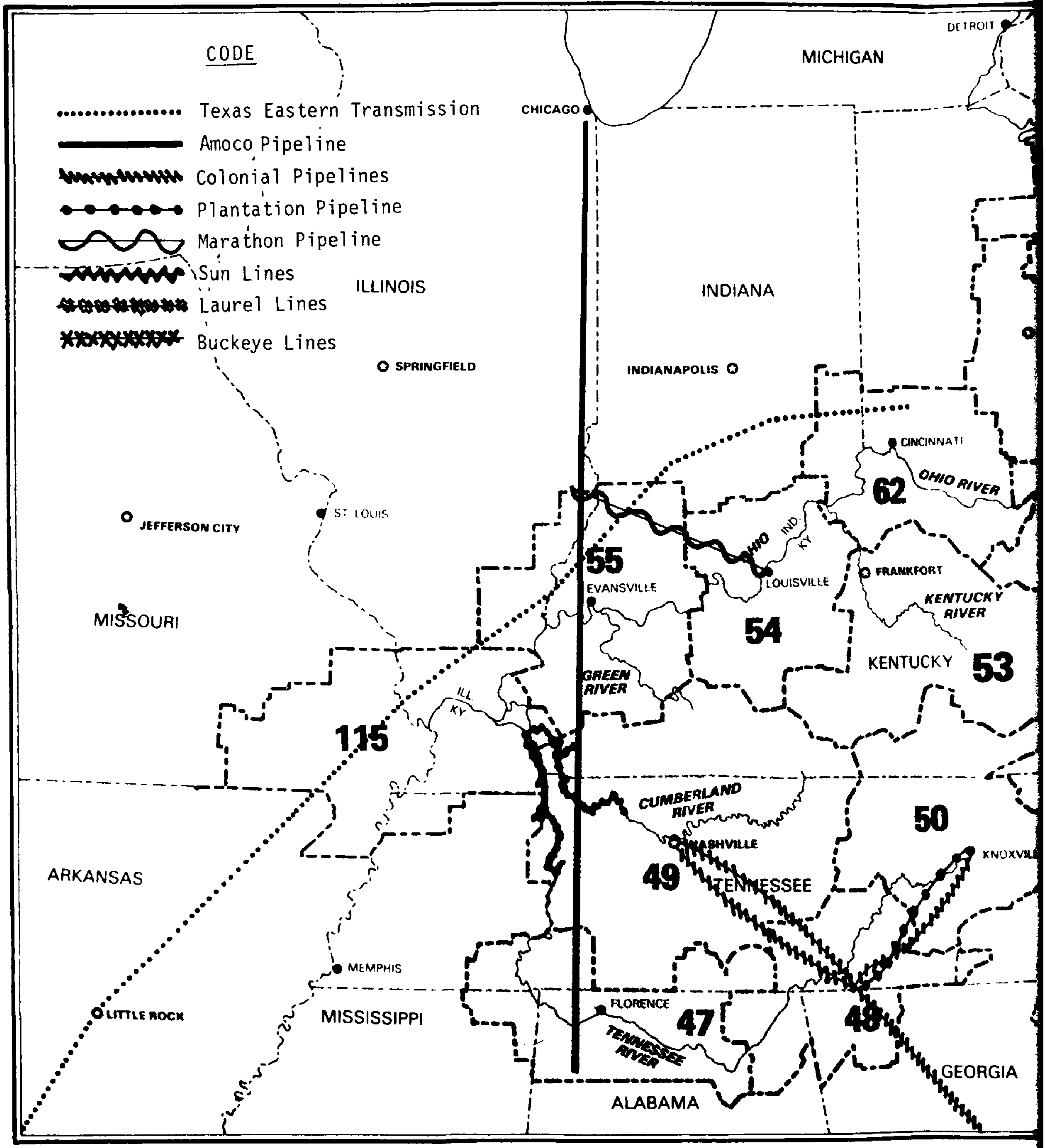
Three pipelines companies own the major products pipelines running through BEAs 66 (Pittsburgh) and 68 (Cleveland). These lines carry petroleum products to ORB consumers from refineries within and outside of the ORB. The Sun Lines control 1,421 miles of three to 16-inch line between Akron and Philadelphia. This system has a 25 thousand tons per day capacity. The main line serving the ORB is 10 inches in diameter and runs through Ellsworth, Ohio; Boardman, Ohio; Van Port, Pennsylvania, and; Allegheny, Pennsylvania.

The Laurel Line forms a 451-mile system of pipelines between Cleveland and Philadelphia through BEA 66 (Pittsburgh) and has the capability of carrying 20 thousand tons of products a day. A

---

1. Worldwide Pipelines and Contractors Directory, 1977 ed. (Tulsa: Petroleum Publishing Company, 1979).

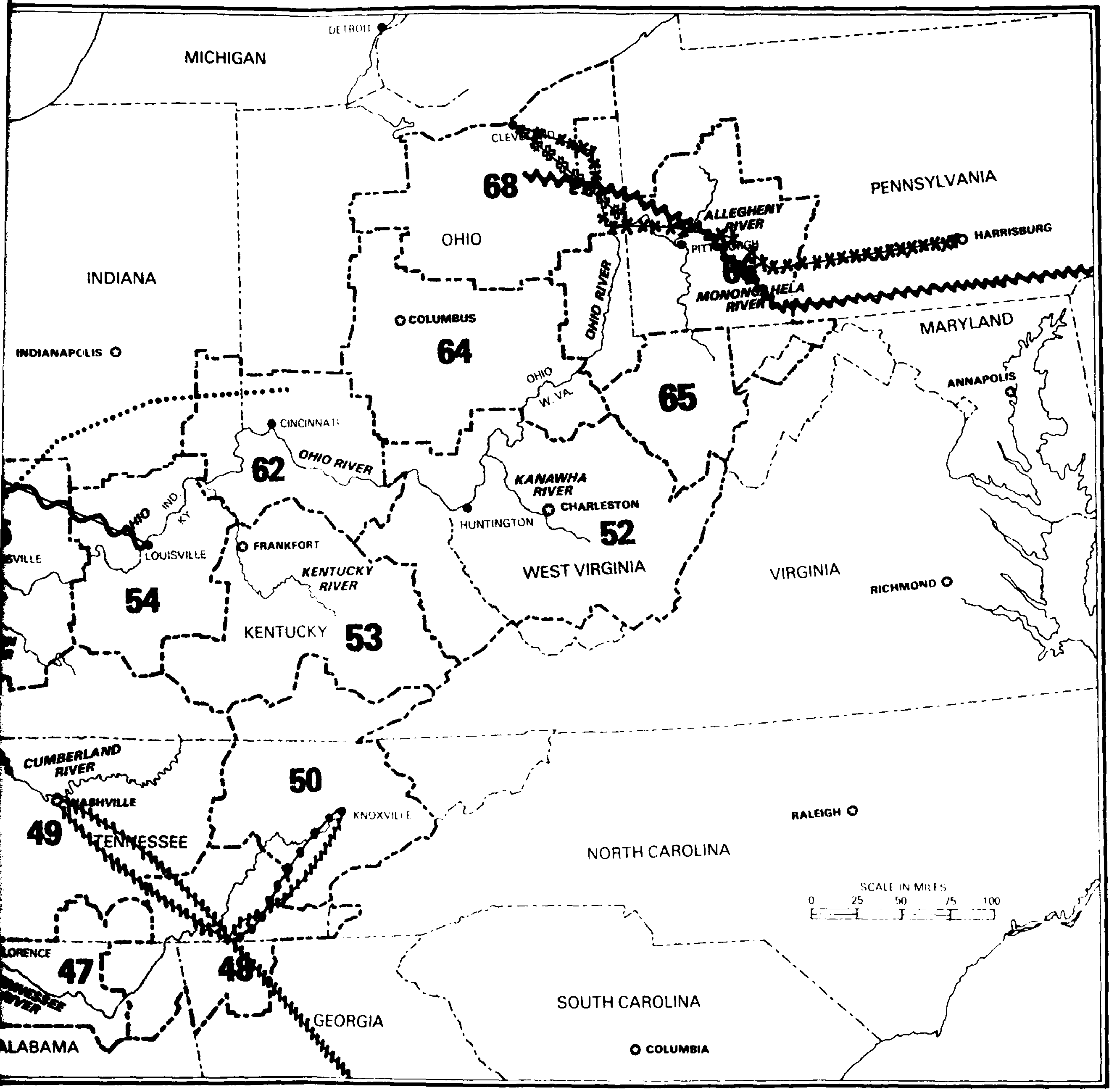
MAP B-3. PETROLEUM PRODUCTS PIPELINES IN THE O



Source: Petroleum Products Pipeline Map of the United States, 1979 ed., American Petroleum Institute.

Primary Study Area

PETROLEUM PRODUCTS PIPELINES IN THE OHIO RIVER BASIN



States, Primary Study Areas

2

14-inch line which goes from Cleveland to Midland, Ohio via Atwater and Ellsworth, Ohio is the major ORB line.

The third major line serving BEAs 66 (Pittsburgh) and 68 (Cleveland) is a 10-inch diameter line owned by Buckeye Pipeline Company.

The Texas Eastern Transmission pipeline is a 20-inch line which runs from the Texas Gulf to Central Ohio and serves BEAs 55 (Evansville), 62 (Cincinnati) and 115 (Paducah).

A Marathon 16-inch line, part of the 1,395-mile Marathon pipeline system, with the capacity to pump nearly 53 thousand tons of petroleum products a day, carries petroleum products from Robinson, Illinois to Louisville, BEAs 54 (Louisville) and 55 (Evansville).[1] The line also carries petroleum products to outside areas from ORB refineries in BEA 55 (Evansville).

An eight-inch Amoco line from Chicago to Decatur, Alabama supplies petroleum products to consumers in BEAs 49 (Nashville) and 55 (Evansville).

1. The Robinson-Lousiville line has been in operation since 1977.

VII. SOURCES AND REFERENCES

A. Reports and Publications

Howrey & Simon. Pipelines Owned by Oil Companies Provide A Pro-Competitive and Low Cost Means of Energy Transportation To The Nation's Industries and Consumers. Washington, D.C.: n.p., 1978.

Indiana Department of Natural Resources. Geological Survey. Petroleum Industry in Indiana. Bulletin 42-N. By G.L. Carpenter, T.A. Dawson, S.J. Keller. Indiana: n.p., 1975

Federal Energy Administration. National Energy Outlook. Washington, D.C.: GPO, 1976.

"Future Refinery Capacity Needs, Construction Incentives and Processing Configuration." Oil & Gas Journal, 22 July 1977.

McNeil, Bob. "1979 Forecast, 20,228.90 Miles of New Lines Planned Worldwide." Pipeline, Jan.-Feb. 1979, pp. 10-19.

Oak Ridge National Laboratory. Regional and Urban Studies Section. Energy Division Research. Energy Availabilities for State and Local Development: A Methodology and Data Overview. By P.L. Rice and D.P. Vogt. Sponsored by the Economic Development Administration of U.S. Department of Commerce. Oak Ridge, TN: ORNL, 1978.

Oak Ridge National Laboratory. Regional and Urban Studies Section. Energy Division Research. Energy Availability for State and Local Development: Projected Energy Patterns for 1980-1985. By D.P. Vogt, P.L. Rice, and V.P. Pai. Sponsored by the Economic Development Administration of U.S. Department of Commerce. Oak Ridge, TN: ORNL, 1978.

Robert R. Nathan Associates, Inc. Alaska North Slope Crude Oil; An Economic and Financial Assessment of Distributional Alternatives. Washington, D.C.: RRNA, 1978.

U.S. Army Corps of Engineers. Interstate Commerce Commission Railroad Waybill Sample. 1969, 1972, 1976. Data provided on computer tape.

U.S. Army Corps of Engineers. Waterborne Commerce by Port Equivalents. 1969-76. Data provided on computer tape.

U.S. Department of Energy. Energy Information Administration. Energy Data Reports: Crude Petroleum, Petroleum Products and Natural Gas Liquids. 1977 ed. Washington, D.C.: DOE, 1977.

U.S. Department of Energy. Energy Information Administration. Division of Consumption Data Studies. Federal Energy Data System (FEDS) Technical Documentation. By Raymond F. Fuller. Washington, D.C.: GPO, 1978.

U.S. Department of Energy. Assistant Secretary for Policy and Evaluation. Office of Policy Analysis. Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000. Draft Report. Washington, D.C.: GPO, 1979. Vols. I and II.

U.S. Department of Energy. Energy Information Administration. Projections of Energy Supply and Demand and Their Impacts. Vol. II of Annual Report to Congress. 1977 ed. Washington, D.C.: GPO, 1978.

U.S. Department of Energy. Energy Information Administration. Statistics and Trends of Energy Supply, Demand and Prices. Vol. III of Annual Report to Congress. 1977 ed. Washington, D.C.: GPO, 1978.

U.S. Department of the Interior, Bureau of Mines. "Crude Petroleum and Petroleum Products." Minerals Yearbook. 1976 ed. Washington, D.C.: GPO, 1979.

U.S. Department of the Interior. Bureau of Mines. Mineral Facts and Problems. 1975 ed. Washington, D.C.: GPO, 1976

U.S. Department of the Interior. Bureau of Mines. Mineral Industry Surveys: Crude Petroleum, Petroleum Products, and Natural Gas Liquids. 1969 and 1976 eds. Washington, D.C.: Bureau of Mines, 1969 and 1976. (Now published by U.S. Department of Energy, Energy Data Reports).

U.S. Department of the Interior. Bureau of Mines. Mineral Industry Surveys: Petroleum Refineries in the United States and Puerto Rico, January 1. Washington, D.C.: Bureau of Mines, 1969-76. (Now pubiished by the U.S. Department of Energy, Energy Data Reports).

B. Industrial Shippers and Receivers

Ashland Petroleum Company, Ashland, Kentucky.

Louisville and Nashville Railroad, Birmingham, Alabama.

Marathon Oil, Inc., Louisville, Kentucky.

Mid-Continental Oil & Gas, Wahsington, D.C.

People's Gas Company, Washington, D.C.

Shell Oil Company, Houston, Texas.

Sohio Petroleum Company, Washington, D.C.

Triangle Refinery, Louisville, Kentucky.

C. Associations, Government Agencies and Educational Institutions

American Petroleum Institute, Washington, D.C.

Association of Oil Pipelines, Washington, D.C.

Branch of Petroleum Production and Processing, U.S. Department of Energy, Washington, D.C.

Commission on Energy and Environment, Charleston, West Virginia

Consumption Office, Energy Information Administration, U.S. Department of Energy, Washington, D.C.

Independent Petroleum Association, Washington, D.C.

Information Office, Federal Energy Regulatory Commission, Washington, D.C.

Oil Pipeline Board, Federal Energy Regulatory Commission, U.S. Department of Energy, Washington, D.C.

Office of Energy Data Interpretation, U.S. Department of Energy, Washington, D.C.

Office of Pipeline Safety, U.S. Department of Transportation, Washington, D.C.

Operation and Resource Allocation Office, U.S. Department of Energy, Washington, D.C.

Pipeline, Houston, Texas.

Pipeline Producer Regulatory Office, Special Assistant, U.S. Department of Energy, Washington, D.C.

Pipeline and Underground Utilities Construction, Houston, Texas.

U.S. Department of the Interior, Bureau of Land Management, Washington, D.C.

DATE
FILMED

– 8